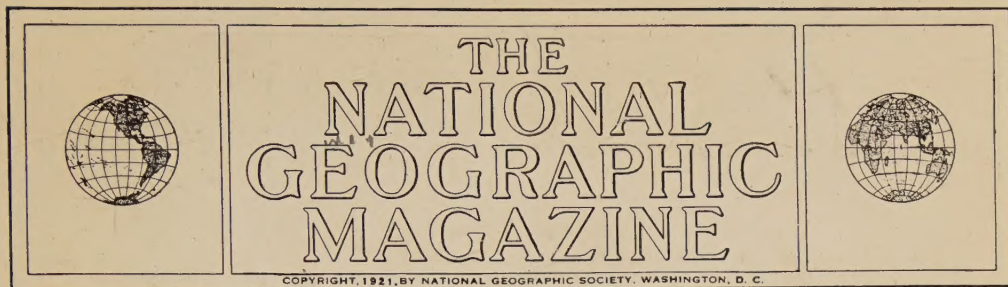


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THE WILD LIFE OF LAKE SUPERIOR, PAST AND PRESENT

The Habits of Deer, Moose, Wolves, Beavers, Muskrats,
Trout, and Feathered Wood-Folk Studied
with Camera and Flashlight

BY GEORGE SHIRAS, 3D *

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CHAPTER I

LAKE SUPERIOR is nature's greatest reservoir of deep, pure water in the world. Four hundred and fifty miles long, one hundred and sixty-seven miles wide, having a maximum depth of a thousand feet, its bottom four hundred feet below sea-level, with some two hundred tributary streams and the greatest snow precipitation east of the Mississippi, this great crescent-shaped basin has remained at the same level for centuries.

Overflowing, in a series of tumultuous

*In 1849 the paternal grandfather of the author visited Lake Superior to fish for speckled trout, at a time when there was only a scattered settlement or two, and before a lock had been constructed around the rapids at the head of St. Marie's River. In these vast waters he fished until his 89th year.

Then in 1859 came the father, as a fly-fisherman, later a Justice of the United States Supreme Court, who now, in his 90th year, continues his annual visits.

Finally came the author in 1870, who herein describes his own experiences of fifty years, first with the rod and gun, and then with the camera and flashlight, which brought to the sportsman and the naturalist a new pleasure and a new means of studying and photographing wild life.—EDITOR.

rapids, the rock-rimmed shore at the eastern end, the excess waters have channeled out the beautiful Sault Ste. Marie River, with its wooded islands and many bays, passing thence through straits, rivers, lakes, and a great estuary to the sea, two thousand miles away.

PRIMITIVE ROCKS AND VIRGIN WATERS

The ancient formations of Lake Superior are grouped into three great divisions—the Archean, Algonquin, and Cambrian—each separated by unconformities of great magnitude. While of interest to the geologists, for here are the finest iron and copper deposits in the world, besides marble and granite, slate and sandstone, the basic divisions may be treated as rocks of crystalline and sedimentary origin.

Included in the latter is the "Lake Superior sandstone," unique in containing little or no fossil remains, indicative of its early formation.

The surfaces of the primary rocks are heavily scored by glacial action, while the overlying strata of sandstone, often many thousand feet thick, have been fashioned by the elements into fantastic and impres-



Drawn by A. H. Bumstead

A MAP OF LAKE SUPERIOR SHOWING NORTHERN MICHIGAN AND WISCONSIN, EASTERN MINNESOTA, AND WESTERN ONTARIO

Among the points of interest mentioned in the narrative and indicated on the map are: Marquette, Whitefish Lake, Grand Island and Pictured Rocks, St. Ignace Island, and Stan-
nards Rock.

sive shapes, resembling battlements and turreted castles, separated by high, perpendicular cliffs of variegated colors.

These cliffs contain caverns into which the larger craft may enter. One group on the southern shore is known as the "Pictured Rocks," originally the most famous of our natural phenomena, but now somewhat overshadowed by the magnitude and diversity of the Rocky Mountain region though still without a counterpart in coastal scenery (see pages 116, 117, 118, and 144).

In topography and scenic beauty the north shore resembles somewhat the southern shores of Alaska, for it is elevated, rock-bound, with many clear, turbulent trout streams cutting through the dark coniferous forests and plunging down the steep water-shed into the crystalline waters below.

WILD LIFE ON THE ISLANDS

Here is also an archipelago of wooded islands, some surmounted by rocky domes of a thousand feet or more, the larger containing moose, deer, caribou, and bear,

between which and the main shore are deep, tortuous channels and many safe harbors, affording ideal cruising grounds for the sportsman and tourist.

The south shore resembles more the northern Atlantic coast, with here and there precipitous cliffs and rocky promontories, separated by long stretches of sand beaches and deep bays, the islands and harbors infrequent.

PRIMEVAL FORESTS AND SUCCESSIVE GROWTHS

Circling the coast, the forests are much the same, except that the rotund spruce of Ontario is replaced on the Michigan shore by towering hemlocks, the roots of which turn the streams into a deep wine color; so that the speckled trout, in darker hues of brown, red, and orange, are in characteristic contrast with the silver and pink of those in the lake.

When travel by water was the principal means of seeing the lake country, it was assumed that upper Michigan was a vast pinery, for its shores and the interior streams were fringed with green through-



DOME-SHAPED LODGE OF THE OJIBWAYS

The Indian to the right is Chief Kawbawgam, who with his family lived on Presque Isle, now a suburban park of Marquette. He reached the unusual age of one hundred years, and now a large boulder is his monument in the park. The standing figure at the left is Jack La Pete, who acted as guide for four generations of the author's family. He died in his ninety-eighth year. Such longevity was most unusual among these Indians.

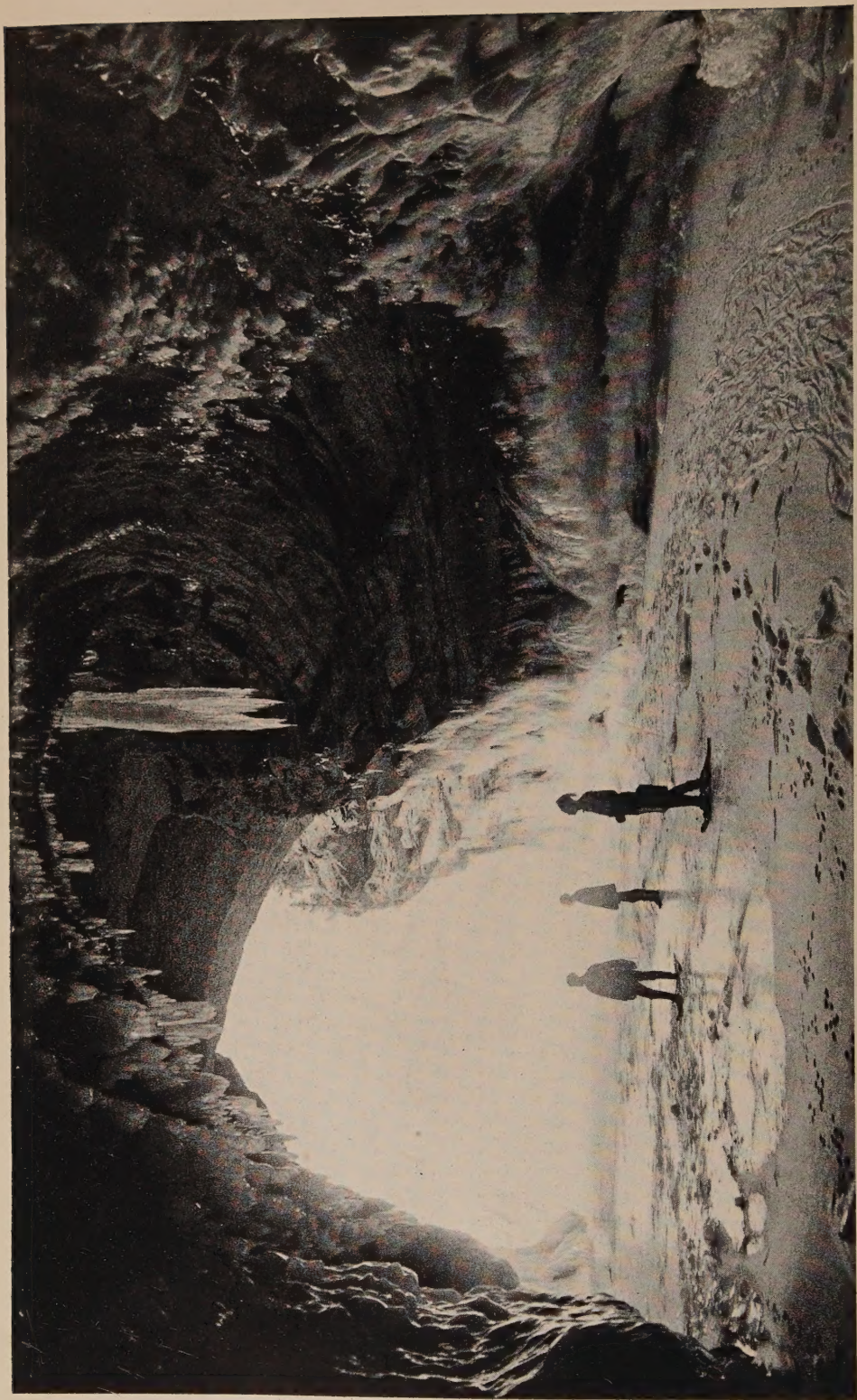
out the year, and visible in the open months were the buoyant pines floating down many streams to be rafted on the lake for the eastern market.

When the railways and the logging roads reached the higher ground, extraordinary forests of hardwood were discovered, consisting of millions of acres of sugar or hardwood maple in solid stands, with an abundance of beech, yellow birch, basswood, ash, and elm, resulting in the development of many woodworking establishments and the largest wood charcoal furnaces in the world (see page 122).

The abundance of sugar maples at the present time warrants a syrup production exceeding Vermont and New Hampshire, where generations of thrifty farmers have tapped every scattered grove in conserving nature's sweetest offering.

Nowhere, probably, on the continent is the fall foliage more beautiful in brilliancy or contrasting colors. Much of this gorgeous display is of recent origin, for with the removal of the older forests, the increase of rural clearings, and the unending vistas of the interior driveways came a second growth of low-branched, symmetrical trees, one of which, the soft maple, is spreading rapidly; for, when cut to the ground, from the stump springs a spray of green saplings, in the autumn turning to a fountain of pink and red, many of the leaves spotted like a painter's palette.

Equally abundant is the yellow-leaved poplar, fluttering in the slightest breeze, while the bronzed beeches and the lavender of the wild cherry are interspersed with the mountain ash, bending beneath



Photograph from Longyear Expedition

WINTER'S HANDIWORK: PICTURED ROCKS

In the summer the transparent waters disclose the curved bottom of this rotund and gloomy cavern. When winter paves the floor in white, fills the lower crevices with ice, and forms pendant prisms on the arched entrance, the transformation is one of radiance and beauty.



Photograph from Longyear Expedition

GRAND PORTAL : PICTURED ROCKS

A winter view of a large cavern in the variegated sandstone cliffs east of Grand Island, where surging waves have formed a wainscoting of ice, and a myriad of stalactites on the domed ceiling. Occasionally the ice contents remain until July first.



MINER'S CASTLE: PICTURED ROCKS

With the base resembling Carrara marble, this striking design of Nature has been much changed in winter.

its clusters of red berries, the more brilliant hues alternating with the contrasting greens of the balsam and cedar, and back of which often lie great uncut forests of hardwood maple in a monotone of orange, the edgings carpeted with the crimson hether of huckleberry, while daisies, goldenrod, and giant ferns join in the culminating efforts of the ebbing year.

The interior lakes and ponds present the climax of this hectic season; for nature, flushed with intermittent frosts, duplicates its colors on the mirrored surfaces, all domed with the azure of the northern sky.

THE OJIBWAY INDIANS

Lake Superior was thoroughly explored and was a busy field for the Jesuit missionaries long before any other portion of the western country had been visited by the white man, for the hardy *voyageurs* used the great watercourse from the sea when settlements on the Atlantic coast were few and far apart.

In 1658 Radisson, the fur trader, gave the first written description of the south shore, followed in 1660 by Father Menard, in 1665 by Allouez, and in 1669 by Marquette. Some evidence exists for believing that this region was visited by white men long before these dates, it having been asserted by Chase S. Osborn, former Governor of Michigan, that so far back as 1542 Roberval's men penetrated thus far.

Among the first of the resident Indians on Lake Superior were the Ojibways, commonly called Chippewas. Belonging to the Algonquins, it is supposed they were driven west, along the Great Lakes, by the more warlike Iroquois, and on reaching the terminal waters found the Sioux, a tribe of similar habits and disposition, in possession.

Then ensued a bitter warfare; but the Ojibways, having a continuous supply of guns and ammunition from the east, drove their rivals out on the prairie country, where they became pony Indians, changing their habits materially.

The dividing line between these contending forces was Minnesota, the wandering trapper being able to recognize the different tribes by the tall, conical-shaped lodges of the Sioux and the low-domed ones of the Ojibways (see p. 115).

Hunting, fishing, trapping, and the use of the birch-bark canoe developed self-reliance and a habit of occupying more or less permanent locations within sight of the water, in contrast to the nomadic life of most western Indians.

THE INDIANS LIVED LARGELY ON FISH

In the early days there were neither moose nor deer and very few caribou, compelling the aborigines to live largely on fish, which were easily obtained from the Sault Ste. Marie River, where the rapids remained open during the winter, and here was established their largest village, bringing them into contact with travelers, whom they served as guides and packers. They were recognized as the most dependable and responsive members of their race, for early intercourse with the missionaries prepared them to welcome the white man as a friend.

At the present time the Ojibways have practically disappeared from the south shore, but are still to be found in considerable numbers throughout western Ontario and northeastern Minnesota, where the abundance of fish and game, supplemented by an annual pension from the United States and Canadian governments, favors their existence. Under conditions very similar to those of a hundred years ago, sportsmen and tourists are given an insight into the life of the tribe which inspired the story of Hiawatha.

CHAPTER II

FIRST OUTINGS TO LAKE SUPERIOR

In 1869 I was presented with my first gun, a small-bore, muzzle-loader, with which, under parental instruction, I was able to bag a few squirrels, quail, and rabbits in the wooded country below Pittsburgh, on and near the banks of the Ohio.

This gift was in view of a coming trip to Lake Superior the following year, where I was to be permitted to travel on ancestral trails to a region of hearsay, and to see with my own eyes this wonderful body of water and tributary streams, the great forests of pine and hardwood, the picturesque Ojibway Indians in their birch-bark canoes, and, more than all, the trout, grouse, wild pigeons, deer, bears, wolves, and many fur-bearers which

tenanted the streams and arboreal retreats of a pristine wilderness.

Fated to continue on and on in this inherited privilege, half a century has now passed in a study of the wild life in a great homogeneous area, where the extinction or marked declination in certain forms have been compensated by the gradual appearance of species new to the region, accompanied by the gradual increase of some of the more valuable birds, animals, and fish so improvidently decreased in pioneer days.

Anxious to see the surrounding wilderness, a chance came to me when a family party started on a camping trip to the mouth of Huron River, fifty miles to the west of Marquette, a remote portion of the southern shore, where there was not a single habitation between the town and the camping place.

Transported by steamer to within five miles of the shore, several yawls, with canoes in tow, were soon under way. Passing the Huron Islands, dotted white with nesting herring gulls, among the first of the northern bird refuges to be established by President Roosevelt thirty-five years later, we landed in a small clearing near the entrance to the river, where the tents were erected, and then began ten most interesting days beneath the canvas.

INDIAN GUIDES OBJECTS OF INTEREST

The Indian guides were, perhaps, the object of greatest interest, for they gave much attention to the two young members of the party, whose incessant questions were only equaled by raids on the provision tent.

Trout, grouse, and pigeons were abundant and many deer tracks along the banks indicated what might be done in the hunting season.

Among the guides was one first employed by the writer's grandfather in 1850. His swarthy complexion and comical expression led to his being called Jack La Pete, through a supposed resemblance to the Jack of Spades (see page 115). Jack was small, thin, and active, with a volubility in striking contrast to the taciturnity of his race, a trait possibly due to a trace of Hibernian blood, for in other respects he resembled the Ojibway Indians.

During long contact with the better class of pioneers, who were intent upon the permanent development of a country rich in minerals and timber, and often acting as guide to those seeking to enjoy the abundance of game and fish, Jack became possessed of a greater knowledge of worldly affairs than any of his associates, and the fact that he had spent a year in Washington as interpreter in litigation affecting his tribe added further prestige.

About the camp-fire in the evening he made us little birch-bark canoes initialed with the quills of the porcupine, while the spreading tail of the grouse became a fan and the skin of a muskrat was made into a shot-pouch. In conversation he was equally active, and told many weird tales, including a personal interview with the great Manitou, who on one occasion came down the clay chimney of his cabin and with a mysterious incantation restored Jack's failing eyesight.

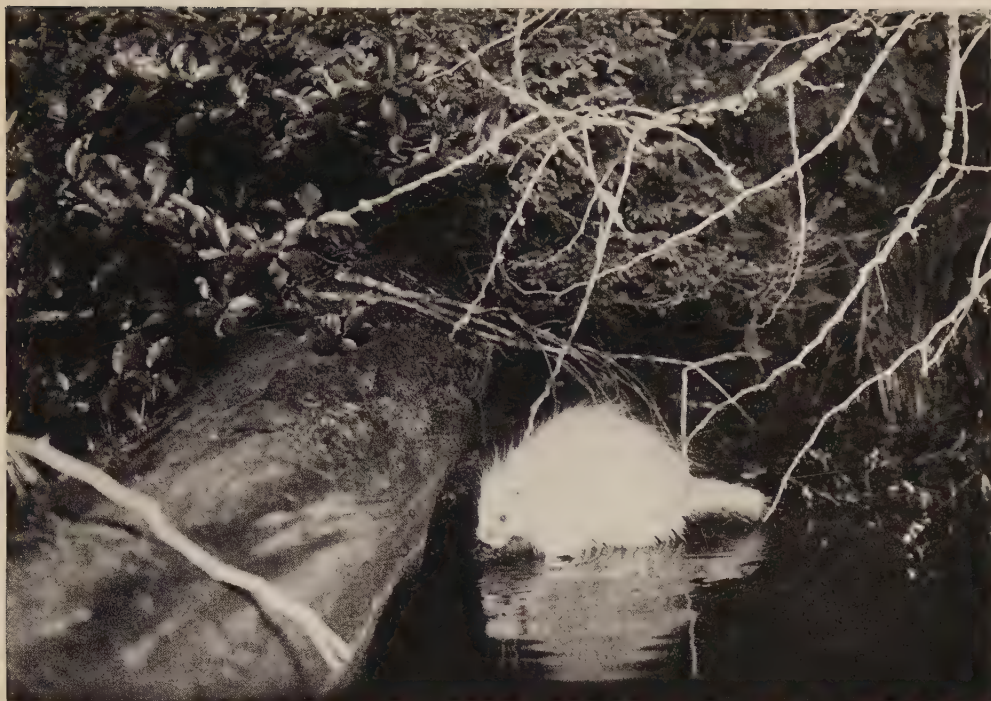
A NIGHT'S CAMP AT THE MOUTH OF DEAD RIVER

Being much impressed with the experiences of the first camp, three boy companions between the ages of nine and twelve were selected for a one night's visit to the mouth of Dead River, several miles north of town. The enterprise was to be undertaken without the assistance of guides or elders, so prone to interfere with the freedom of youth.

Marquette, like most early communities of the north, had no suburbs, and when one stepped out of the backyard, there began the domain of the wild, for the rigorous winters, deep snow, and lack of conveniences deterred any but Indians living outside the settlement.

Assisted up the beach by a one-horse wagon, the outfit was deposited beside a pyramidal rock where the river entered the lake, at which place there was plenty of drift-wood for a continuous camp-fire, axes being barred as well as guns, and, moreover, no one was to wade the shallow river on account of quicksands and because the pathless swamps and dense forests beyond were reported to be occupied by beasts having a particular preference for small boys.

The tent, when erected, leaned much to one side, in response to a crooked pole;



Photograph by George Shiras, 3d

FLASHLIGHT OF AN ALBINO PORCUPINE

For seven consecutive summers this animal was photographed at night in the same bay on Whitefish Lake. (See "A Flashlight Story of an Albino Porcupine and of a Cunning but Unfortunate Coon," June, 1911, NAT. GEOG. MAG.)

but this was deemed a virtue, according to one of the party, because the sagging canvas would keep our feet warm, the coverings consisting of a single blanket each.

COOKING UNDER DIFFICULTIES

The remaining part of the day was spent in fishing, and after the trout were cleaned and an indescribable batter prepared for the flapjacks, it was discovered the lard and butter had been left behind. But burned fish and flapjacks pried off the frying-pan with a knife were not discouraging, for there was an abundance of jam, bread and cookies, and in the tent was a large beefsteak for breakfast, which, in the absence of grease, would now be broiled on a spit before the fire.

As dusk approached, a roaring sound came from the interior and gradually grew louder. The suggestion that it was a great forest fire sweeping toward the lake and would soon engulf us nearly sent the party scampering home, but the absence of either smoke or flame seemed

to upset this prediction, and the mystery was left unsolved.

The wind, shifting from the lake to offshore, had brought in hearing the sound of some large falls; but such a simple explanation was not in the minds of youths about to spend the night in the region, growing more fearsome as the camp-fire accentuated the oncoming darkness.

It fell to my lot to occupy the front of the open tent, but as the warmth of the fire had advantages and the glare would keep away the prowlers of the night, I was soon asleep with the rest. About midnight the fire burned low, and to keep warm the blankets were drawn over the heads of each.

TERROR IN THE TENT

Suddenly I heard a snuffling sound beyond the tent, and then a couple of heavy feet pressed down on the blanket, followed by some animal seizing the package of meat and dragging it away.

Still enveloped in the covering, I man-



Photograph by George Shiras, 3d

A RACCOON FIRES THE FLASHLIGHT

Twenty-five years ago this omnivorous animal was unknown on Lake Superior, but on the coming of the second growth clearings and farming settlements it has taken up a permanent abode. (See "A Flashlight Story of an Albino Porcupine and of a Cunning but Unfortunate Coon," June, 1911, NAT. GEOG. MAG.)

aged to roll over the recumbent figures, shouting, "Bears! Bears!" until the closed end of the tent prevented further progress. Then there was a jumble of outcries and an effort made to occupy the same place in the rear, followed by the rapid firing of a revolver toward the opening by one of the party, who declared in excited tones that the prohibited weapon had been brought along for just such an occasion, for he knew we were in a country filled with dangerous animals.

Under the protection of this weapon, the fire was replenished, and then at the edge of the swamp appeared the glowing eyes of wild creatures held at bay by the blazing logs, for the flittering fireflies above the moist ground were sufficiently realistic at this juncture to deceive all.

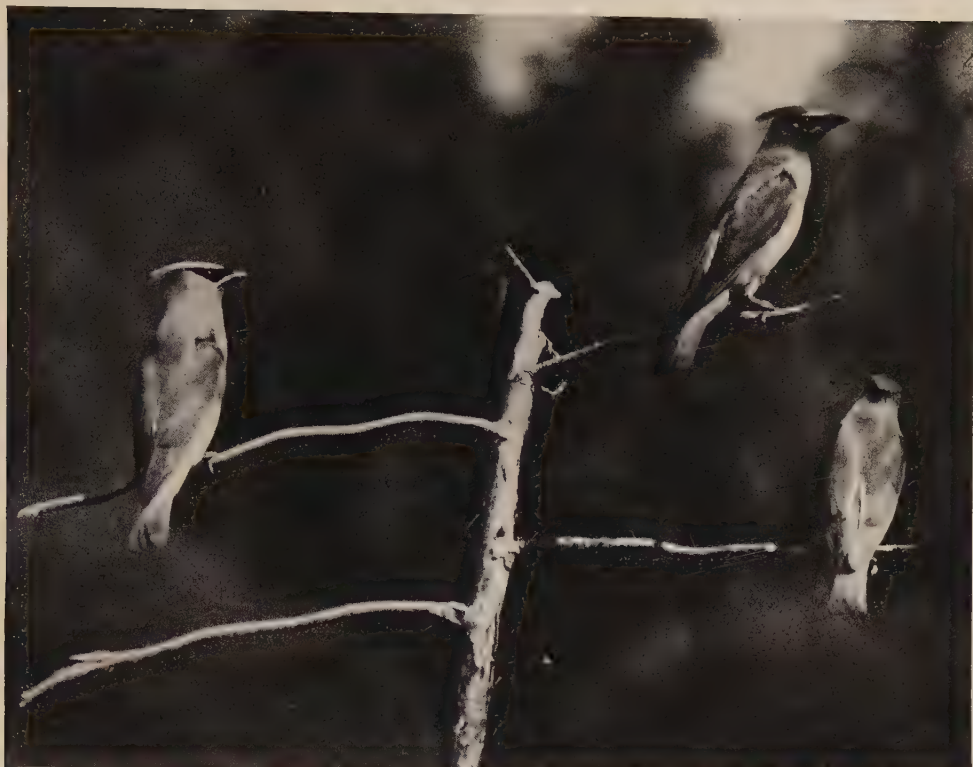
At daybreak the camp was abandoned, but not before large tracks were noted on the sandy beach. When each appeared

at his respective home before any one had arisen, it was discouraging to be told that our visitor was, of course, only a stray Indian dog.

THE WORLD'S LARGEST CHARCOAL FURNACE

As showing how this particular camping place changed, it may be noted that the largest charcoal furnace in the world is now in operation on one side of the river, which is spanned by a steel bridge, and just beyond is the largest concrete ore dock on the Great Lakes, where leviathan freighters six or seven hundred feet long have replaced the birch-bark canoe. A shore driveway, with its multitude of automobiles, occupies the sand beach which once registered the tracks of many wild animals—and others not quite so wild, but equally fond of rare steak.

Early in August one of my youthful companions of the previous camp learned that two miles south of the town and



Photograph by George Shiras, 3d

CEDAR WAXWINGS NEAR THE CAMERA

In July, 1892, while watching for deer, cherry-birds were observed flying over the water after white millers. A stick with branches at right angles was placed near the blind and a camera, with a pulling string attached, was set up only three feet away from the perch. Soon a single bird was pictured; then two, and finally the three shown above.

several hundred yards above the mouth of Carp River was a salt lick much frequented by deer, for the valley beyond was a wilderness, visited only by a few trout fishermen early in the season. The animals came down the well-forested stream to the lick almost in sight of the highway following the lake shore.

Here, accompanied by a colored servant, he was placed on the top of a scaffold facing a salted log and within an hour had killed a deer, using a Martini-Henri carbine, the forerunner of the modern repeating rifle.

Then ensued great excitement among the boys of the neighborhood, and it was deemed a special honor when I was selected to try for a deer in company with the successful hunter, the exact location of the lick being unknown to the rest of us.

Several days later, on reaching the

place, I found a high scaffold supported by four poplar trees and ascended by a rickety ladder, the general appearance indicating that it had been used as a convenient spot for killing deer by some one who found it unnecessary to go much beyond the town limits for his venison.

An old log had been bored full of auger-holes and filled with salt, so that each rain caused the salt water to overflow, keeping the lick continuously fresh. For about ten feet on each side of the log the trees had been removed, giving a full view of any animal standing in the opening.

A TRAGEDY AVERTED

By agreement I was to fire the shotgun first, followed by the carbine to insure getting the deer. Little time had passed when a twig cracked and both guns were trained on the log, ready for immediate

action. Then a dark figure appeared and bent over the log, fortunately recognized, however, as a human being and evidently the proprietor, from the manner in which he examined the premises for signs of deer.

Had he looked skyward and seen the battery trained in his direction and the trembling fingers pressed against the triggers, he would doubtless have had some concern. However, he soon withdrew, and again we awaited expectantly, when, suddenly and without sound, a deer was seen standing on the opposite side of the log, with ears erect and nostrils twitching in an effort to detect any danger.

Counting three, the shotgun was fired, followed a moment later by my companion's, and then the animal whirled and was gone as silently as it came. Descending, we found that the deer had crossed the stream, and after trailing it some distance without finding any traces of blood, we returned much disappointed.

Just at dusk, on preparing to leave, a deer whistled near by, showing that so much tramping about the vicinity had given the needed warning. Much crest-fallen and somewhat sensitive to my companion's declaration that had he shot first, there would have been a dead deer, I returned to town, wondering if such a favorable chance would ever occur again.

For more than fifteen years the State penitentiary, a huge brownstone building, has stood on the bank of the river just above where the lick was, and now some five hundred convicts gaze wistfully upon the still peaceful valley in which the unfettered creatures of the woods continue to roam.

THE DISCOVERY OF WHITEFISH LAKE

Several days later old Jack came shuffling along, looking for a job. When he heard of the unfortunate adventure with the deer, he told how he had discovered, two years before, a beautiful little lake away back in the unexplored forest, twenty miles east of his place, where deer were so abundant that one could be killed at any hour of the day or night.

Naturally, this excited my interest, and after further questioning I learned that in the summer of 1869 he had been employed as a mail-carrier by surveyors

looking over a route for a railroad between Marquette and a point on Lake Michigan. When the preliminary survey reached a long, deep gorge, impracticable to bridge on account of the excessive cost, the project was given up.

Jack, however, noting the stream flowing through this valley and the possibility of finding good trapping ground for the ensuing winter, followed the gorge down until he came to a lake about a mile in length, where he saw many deer and much evidence of fur-bearers.

Later he built a half-way shelter at the head of Sand River and a larger one at the lake, where he had a season of successful trapping. Further, it was unnecessary in making this trip to carry anything but a couple of blankets, a gun, and a few provisions; for, besides the cooking outfit at both places, he had an abundance of maple sugar which could be used for tea or made into syrup for flapjacks.

THE BEGINNING OF FIFTY YEARS' VISITS TO THE NEWLY FOUND LAKE

During the second week of August, 1871, with my young brother as a companion, we were driven in a buckboard to an Indian cabin ten miles to the south, near the Chocolay River, where an uncomfortable night was spent on the attic floor alongside several aged and ogress-like squaws.

After a hasty breakfast the packs were adjusted according to the strength of each, and a start was made on a fairly good trail to the river, after wading which the course was determined by trees blazed the year before. The direction was easterly along a maple ridge interspersed with hemlock, where absence of undergrowth made the traveling easy, the few swamps having deer trails that avoided all mud-holes and fallen timber.

At noon the headwater of Sand River was reached, where the little lean-to of Jack's was to be occupied that night. The packs, light as they were, had told on the two very youthful members of the party.

While the lunch was being prepared, the sight of the little stream suggested trout, and much to the surprise of Jack we soon caught a dozen small fish. Like most Indians, Jack had a rather hazy notion about trout fishing in interior waters, since Lake Superior, filled with



Photograph by George Shiras, 3d

A MINNESOTA CONTRIBUTION TO THE SCENIC SHORES OF LAKE SUPERIOR

Minnesota, by reason of its climate, its woodlands and prairies, its countless beautiful lakes and connecting waters, has long been a paradise for wild life and a mecca for the sportsman and tourist. Owing to wise laws and a most efficient game commission, it stands in the forefront of progressive States. At some future time it is the purpose of this Magazine to portray at greater length the out-of-doors attractions of this commonwealth.

whitefish, lake and speckled trout, afforded such an ample and easily obtained supply by the use of the net, that the Indians rarely resorted to the rod.

After the meal the possibility of maple sugar led to a search, when Jack, suspecting what we were after, lifted a heavy, flat stone from the edge of the shelter, exposing a tin can filled with pulverized sugar, the treasure being thus concealed because Bruin had a sweet tooth and otherwise would soon have detected this little store.

A STRANGE NOISE FROM THE WILDERNESS

Toward evening a strange noise came from down the stream, a confusion of bawls and whimpers, which Jack announced as the family bickering of an old she-bear and cubs. Seizing the shotgun, I announced a preference for bears

and suggested that we proceed accordingly. Jack grimly rolled up a shirt sleeve, exposing a shriveled arm, deeply scarred, which he said was the result of a fierce encounter with a bear ten years before, and since he was responsible for our welfare, the bear hunt was off on this particular occasion.

Not until many years afterward did I learn how uniformly harmless was the black bear, even with cubs, and that Jack's misadventure was due to falling on top of a big bear asleep between two logs, and in an endeavor to escape the animal had seized him by the arm under the very natural impression that any one taking such liberties should be repelled by force.

Little time was lost in starting the next morning along a blazed trail leading to higher ground, through which an occasional glimpse of Lake Superior could



Photograph by George Shiras, 3d

YELLOW-BELLIED SAPSUCKER PUNCTURING A
MOUNTAIN ASH

Many insects are attracted by the sweet fluid, furnishing food and a potion to the feathered proprietor.

be had an uncertain number of miles away.

In the final mile or so many deer runways were seen, all converging into larger ones leading toward the lake and each filled with fresh tracks of varying sizes.

Silence was suggested with a view to getting a shot, but Jack said that this was exactly what he was trying to avoid, as a deer killed away from camp meant delay and an unnecessary burden, and so he kept up a continuous chatter.

TYPE OF SHELTER THAT WAS OFTEN USED

At length a small clearing ahead indicated our goal, in the center of which appeared a type of shelter I had occasion to use in later years. It was shaped like a good-sized wall tent, having a narrow opening in the roof for the escape of smoke, with side walls of cedar logs extending up four feet and a double pitched roof of black ash bark.

There probably does not exist a more durable, waterproof, and easily prepared covering for a wilderness camp than black ash bark. The bark is removed from the trunks of the larger trees without difficulty in the spring, cut into sheets four by six feet, and put on, slightly overlapping. The sheets are supported beneath by cross-poles, while cedar strips along the outer surface prevent them from curling.

To one viewing the interior for the first time, the rich dark brown of the inner bark might be taken for a covering of well-tanned cowhides.

The birch bark in use for most Indian tepees along Lake Superior cannot be found in any virgin Michigan forests, for it is a second-growth tree in this region, as is generally the case elsewhere. Being inflammable and of a flimsy character, birch bark is not to be compared with the bark of the ash.

THE FIRST GLIMPSE OF WHITE-
FISH LAKE

On depositing our packs we were naturally eager to see the lake, lying concealed at the foot of the hill a few hundred yards away; but Jack declared the first thing in order was a meal, then the cutting of balsam boughs for the beds, ample firewood, and a general overhauling of the camp before the lake could be visited.

Finally all these preliminaries were over and we started down a steep slope for a body of water which, according to Jack, had been unvisited by any white man since the days of the Hudson Bay trappers, a hundred years before.

Interested as we were, could I then have anticipated what an all-controlling factor this little body of water was to play in the writer's destiny and that of his family, it would have been a much more memorable day.

A glance to the north disclosed a narrow lake about a mile long, heavily forested with pine and hemlock except at the end, where a semicircular growth of

reeds backed by cedars and black ash indicated an outlet stream.

A look to the south disclosed a beautiful slough between high hills, and at the end reeds, water lilies, and sand beaches, through which ran the inlet stream, showing a gorge filled, as far as vision reached, with stately elms, beneath which grew the ever-present alders.

The view on page 192 shows the slough looking toward the lake, which is somewhat obstructed by a point, and on page 134 is the valley down which Jack came when he discovered the lake.

THE CENTER OF THE DEER COUNTRY

In this little slough and the adjacent lands the time was to come when more deer would be killed by market hunters and sportsmen than in any tract very much larger on the American continent, and, what can be stated with more pleasure, it was in this locality that the new sport of hunting with the camera was to be originated, and where more deer were to be photographed by day and by night than elsewhere throughout their entire range.

This was the center of the deer country. Several natural salt licks were located beneath each bank, forming the central points of century-old gathering places of all the deer within a radius of ten or fifteen miles. Here, at any time between spring and early winter, they could be seen almost continuously.

At the time of our first visit none of us knew of this unusual attraction, for from where we stood it was impossible to see the animals close to the bank, and it was not until years later that the muddy and trampled surface and the sight of the deer gulping down this saline mixture indicated the presence of mineral springs, shown by analysis to contain a higher percentage of salt than many of the commercial salt wells in southern Michigan.

While we were intent on noting the surroundings, Jack pulled from beneath the alders what looked like a log, but when turned over proved to be a dugout made from white pine and containing a paddle and a gill-net.

Although made for only one person and used for trapping, we were all such

light weights the boat was deemed large enough to carry two of us when hunting.

Jack soon made another paddle from a dry piece of cedar, and then, according to the rules of primogeniture, I was to go on the first hunt, the lower end of the lake being selected. Before starting, I asked why the slough, with its many runways, was not the best place to watch, and was told that this locality was reserved for fire-hunting that night, in case we had no success in getting one before dark.

Leaving my brother to find his way back to camp, we paddled slowly along the western shore toward the reeds and shallow waters, where Jack predicted it would take but a few minutes to get a deer.

Suddenly he whispered, "Put up your paddle. There is a deer ahead."

But I could neither see nor hear one. Passing some reeds bordering a little bay, I saw, standing within less than thirty yards, a small buck, intent on obtaining the succulent water grasses growing a few inches below the surface.

THE FIRST SHOT

Silently I raised the gun, aimed for the shoulder, and as the black smoke and heavy report evidenced the pulling of the trigger, the deer gave a spasmodic whirl, rushing toward the shore at an extraordinary speed, the water flying in all directions. Once more the gun was discharged, just as the animal, in a single leap, cleared the bushes and disappeared in the cedar brush beyond.

Reverberating echoes from the high ground across the lake did not conceal Jack's chuckle; but he gave assurance of another shot within an hour.

"Another shot!" What a mockery this seemed to one who felt sure that this time the effort had been successful; and, if not, what chance would there ever be of doing better? Therefore, with assumed confidence, I insisted that we would find the deer dead within a short distance. But Jack only laughed and steered the boat toward the opposite shore, for it was evidently his opinion that "buck fever" had given this animal a further lease of life.

After several hours had passed with-



Photograph by George Shiras, 3d

AN ANCESTRAL RUFFED GROUSE

In the fall of 1892, on approaching the author's camp clearing, a cock grouse, clucking and spreading its tail on a branch beneath a wild cherry tree, was pictured with a small hand camera.

out our seeing anything further, we returned to camp, and, following supper, preparations were made for fire-hunting, under the primitive conditions employed by the Indians, it now being my brother's opportunity to provide the venison.

At dusk we went down the winding trail, illuminated by a flaming torch of birch bark from material brought in for this purpose. Placing an old frying-pan in the bow of the dugout, containing a handful of pine knots, with strips of bark near by, to be added when more light was needed, a start was made, and I returned to the camp, which was hardly

reached before there came the crack of the gun.

THE AUTHOR'S BROTHER GETS HIS DEER

After a while the glare of the approaching torch showed Jack leading the way, carrying several pickerel taken from the net at the entrance of the slough, while my brother had the gun in one hand and in the other a stick upon which were impaled the heart and liver of the deer, showing the success of the hunt.

Then came the account of the dugout passing along the slough, when the sound of several deer trampling about in the mud led to the turning of the canoe in that direction, where two pairs of shining eyeballs indicated a choice of victims. When about fifty feet away the luminous eyeballs disappeared and the two animals could be seen looking across the water. Selecting the smaller of the two, it went down without a struggle, and at the landing it was soon dressed and hung up that it might be drained of blood.

During the night I resolved to arise at daybreak and, without disturbing the others, seek the place where my deer had gone ashore, with the vague hope of finding it or, if unsuccessful, to try for another animal single-handed.

THE QUARRY FOUND!

Never having paddled in the stern before, a few strokes were taken on one side and then on the other, and in this slow and clumsy fashion the bay was reached. Here the dried mud on the leaves gave the clue; so, pushing the bow of the boat into the bushes, I leaped clear of the muddy edge, seizing a projecting snag for support. But the snag proved to be the hind leg of my deer!

Sinking down, trembling with emotion, I eyed the crumpled body of the little

buck. Had a humanitarian witnessed the scene it might have looked like contrition over the destruction of a beautiful and innocent creature, but the time had not yet come when the camera was to be substituted for the gun in my big-game hunting.

After recovering somewhat, an examination showed that nine buckshot had passed entirely through the body, piercing both heart and lungs, thus giving an illustration of how far a deer will occasionally run when mortally wounded. But unknown then was the fact that most deer indicate by their actions the effect of a shot; for when missed they bound away gracefully, with the head erect and the white tail aloft, as though giving a farewell salute to the disappointed hunter, whereas on receiving a deadly wound they usually run rapidly instead of bounding, with the head lowered and the tail down, wringing it spasmodically from side to side. To the inexperienced hunter it is, therefore, of prime importance that he note carefully the action of the animal after a shot.

In dragging my deer through the bushes the stiffened limbs caught, and a heavier pull landed the hunter and the animal in the deep mud, making it a difficult task to get the bedraggled trophy aboard.

On nearing the end of the lake, my triumphant shouts aroused the sleepers, who hurried down the hill in the belief that the strangely absent member had gotten into some kind of trouble. But the sight of the dugout and its muddy occupants told the story of the clandestine and successful trip.

THE DEER MEAT WAS CAREFULLY CURED

During the day the meat of the two deer was partly dried in strips before a hardwood fire, and the day following this task was completed, so reducing the weight of the carcasses that all the edible portions were carried home—a lesson in conservation never lost. In later years I was to witness millions of pounds of meat left in the woods each fall by wasteful market hunters, who shipped out only the saddles, leaving the remainder to rot.

During the succeeding ten years, this trip was repeated often, being made each way in a single day, extra packers accompanying the hunters, so no meat would



GROUSE DOZING IN THE SUN

Crop filled with mountain-ash berries. A two-years' closed season, 1918-19, increased these birds beyond any previous numbers (see page 150).



Photographs by George Shiras, 3d

GROUSE IN MOUNTAIN-ASH TREE

On October 1, 1920, the opening day of the hunting season, several grouse were seen feeding on mountain-ash berries and their pictures were taken before a hunter appeared.

be wasted. Finally, in 1881, a railroad was constructed between Marquette and Sault Ste. Marie, passing half-way between Lake Superior and the camp, making it readily accessible (see pp. 188-9).

As I write, the fiftieth consecutive year has passed, during which longer and more frequent visits have been made, many of them recorded in subsequent pages. Seldom has a wilderness camp in this country retained its primitive attractions of forest and wild life so long. During this time many States, then unorganized in the West, have lost a large share of their once abundant game.

CHAPTER III

THE WHITE-TAIL DEER

The white-tail or Virginia deer has a wider distribution on the continent than any other antlered animal, and is likely to continue indefinitely, in many places increasing under suitable laws, aided by its wonderful capacity to adapt itself to changing conditions. It is the favorite big-game animal among sportsmen of America, for the meat is palatable, the antlers symmetrical and attractive, while its cunning becomes an additional incentive to those whose real enjoyment lies in the exercise of skill and persistence in hunting.

Animals like the moose and elk are seldom killed by sportsmen after one or two sets of antlers have been secured; for the great bulk of these animals, the difficulty in saving the meat in remote places, and the ease with which they are shot deter annual hunting, whereas the white-tail, much less in weight and usually within reach of transportation, is sometimes hunted by a sportsman for thirty or forty consecutive years.

While the writer has had an extended experience with various species of white-tails throughout most of the range of this group of deer, from Central America to near its northern limits, the present narrative is confined to those of the Lake Superior region.

The white-tail, while now quite abundant, was unknown on the north shore at the time the writer came to the region, in 1870. Moreover, there were few within a mile of the south shore, due largely to the ever-present Ojibways, so aptly called

"Canoe Indians," who during the summer camped at the mouths of nearly all streams and other places apt to be frequented by deer.

DEER SPENT SUMMERS NEAR LAKE SUPERIOR

But when the country to the south began to be settled most of the deer spent the summers near Lake Superior, stopping first about the small interior lakes and headwaters of the numerous streams where the Indians seldom went before winter.

The writer's early visits to Whitefish Lake illustrated these conditions. The fact that approximately eighty thousand deer were killed each year of 1879, 1880, and 1881, and most of these within ten miles of Lake Superior, shows their extraordinary increase later. Since that time there has been a gradual and steady decline, largely on account of the great increase in hunters and the convenient method of reaching places previously inaccessible.

Every summer and fall, I spent a portion of each week at least with young companions camping on the south shore, traveling usually in a big, staunch row-boat, with a canoe often in tow. Trout fishing was of the best along the open waters, many of the fish being of great size. In the streams were brook trout, so often preferable for the frying-pan, while wild pigeons frequented the burnt-over clearings near the shore, unprotected by law at that time. Grouse were numerous in the same localities.

Whenever the camp was near a small lake, the canoe was carried over, and during the day a deer could generally be killed.

In the course of time all the well-wooded bays and sheltered points for more than a hundred and fifty miles were visited, including each lake and pond and every stream where fish or game abounded.

HEAVY GALES UNKNOWN ON LAKE SUPERIOR

In this long period only once or twice was the party windbound for more than a day and at no time in the slightest peril from wind or waves, showing that this, the greatest of all lakes, is peaceful and dependable beyond compare.



A FINE STRING OF SPECKLED TROUT

Catches such as the above were not unusual in Lake Superior prior to 1885. Average of above fish was $4\frac{1}{2}$ pounds. Fishing in the mouths of all the spawning streams during the month of August accounts for the great decline in numbers (see page 155).

Heavy gales can neither continue nor develop on Lake Superior, as shown by the fact that the maximum wind velocities seldom exceed 40 miles an hour. Not only is this remarkable record in striking contrast to the tornadoes of the Middle West and the hurricanes frequently reaching the Atlantic coast, but likewise in the case of many populous communities.

Here the Weather Bureau figures confirm the writer's conclusions. During a five-year period (1911-1915) the wind on 156 days reached or exceeded 40 miles per hour at Duluth, and in the same period a similar velocity was reached only 21 times at Houghton, 46 at Marquette, and 33 at Sault Ste. Marie, showing that the heavier winds subsided when they reached the lake, and that this vast area of water, instead of breeding gales or accelerating the land winds, had the opposite effect.

Moreover, the heaviest wind at Duluth in 47 years (1873-1920) was 78 miles per hour, in September, 1881, and this was very exceptional, while the highest velocity at this period for Houghton was 60 miles; Marquette, 62, and Sault Ste. Marie, 61—substantial proof that Lake Superior is free from heavy gales. Contrast such a record with the following stations, many of which cover a lesser period:

Mobile, Ala., 115; Buffalo, N. Y., 96; Mount Weather, Va., 110; Charleston, S. C., 96; New York, N. Y., 96; Fort Canby, Wash., 104; Hatteras, N. C., 105; Pensacola, Fla., 120; Key West, Fla., 115; St. Paul, Minn., 102; North Platte, Nebr., 96; Galveston, Texas, 94; Kitty Hawk, N. C., 100; Point Reyes, Calif., 120.

SHIPWRECKS ARE ALMOST UNKNOWN

However, when moderate winds prevail for several days along or across this vast body of water, one may see, under blue skies, great white-capped rollers dashing against the black volcanic rocks or surging high up on the beaches; but no reasonably staunch passenger steamer has ever been sunk on Lake Superior by reason of wind or waves, though occasionally some of the large freight carriers, when the shore and reefs are shrouded in a fall snow-storm, have been wrecked

within the narrowing outlet of the lake; and again, on very rare occasions, an ore-boat, with decks awash, carrying an immense tonnage in its long, steel hull, has developed a structural weakness in a rolling sea and gone like a plummet to the bottom.

Loss of life in launches, sail-boats, or lighter craft has been negligible, and it is doubtless true that on many a small, interior lake or tidal bay there have been more casualties in a single season than during a century on Lake Superior.

MARKET HUNTERS KILLED 150 DEER A SEASON

Other trips were often made into the interior, where chains of lakes offered a change of scenery and of methods of hunting, including always a visit to a little camp near Whitefish Lake. The experiences gained in such widely separated parts of the region were later much enhanced when the camera allowed a longer and better opportunity for studying wild life.

The market hunters seldom killed less than a hundred and fifty deer a season. One hunter happened to locate his camp a few miles south of Whitefish Lake, where almost as regularly as the clock a horse in charge of an assistant passed each morning loaded with saddles of venison, to be shipped by express to Detroit or Chicago, while the remainder of the carcasses were left to rot.

This slaughter in the neighborhood continued for five seasons, with an estimated total of over four hundred deer to one gun. Then a ban was placed on the sale of venison and the killing fell off for a while.

When reference is made to the seasonal migration of wild creatures, we usually have in mind a large class of birds which every year go to and return from the breeding grounds in the north. Certain fish, like the salmon and shad, are migratory, as is the fur-seal and also some insects, including certain butterflies, but among the game mammals of our continent only the buffalo and caribou may be regarded as true migrants.

However, some species of the deer family, such as the elk and mule deer of the Rockies and the moose of Alaska, ascend regularly in the spring to higher



Photograph by George Shiras, 3d

TIMBER WOLVES POISONED ON WHITEFISH LAKE

Next to man, these animals are the most destructive foe of the white-tail deer in the upper lake region. Fourteen years ago, during a severe winter, when deep snows were crusted for several weeks, the wolves destroyed nearly all the deer within a ten-mile radius of Whitefish Lake. From the carcasses found it was estimated that over two thousand deer were killed in this limited area. A deer's fear of a wolf is only equalled by a wolf's fear of man (see pages 160-166).

grounds for better food or to escape insect pests, returning again when deep snows or killing frosts make the lowlands preferable.

But such movements, though well defined and participated in by hundreds and sometimes thousands of animals, are altitudinal and not latitudinal, and therefore not deemed migratory in the accepted sense, because they may travel to the north, east, or west in their ascent or descent each year, and this usually occurs when retreating or increasing snows regulate their movements.

With the true migrant the condition of the prevailing temperature, either in the spring or fall, has little to do with the

migration, however much it was the original cause, for birds of many species travel at about the same periods each year, regardless of any then-compelling necessity.

DEER CHANGE THEIR MIGRATION HABITS

On the south shore of Lake Superior, including all of northern Michigan and Wisconsin, there once existed a spring and fall movement of the white-tail deer which possessed all the characteristics of a true migration. As this habit was abandoned more than thirty-five years ago, after continuing, doubtless, for centuries, it is worthy of record, especially in view of the fact that those who were



Photograph by George Shiras, 3d

WHERE ANIMAL FLASHLIGHT PHOTOGRAPHY HAD ITS BIRTH: THE SLOUGH AT
THE END OF WHITEFISH LAKE

In this small area more deer were killed, and later more photographed by day and by night, than in any similar locality on the continent. Natural salt licks were one of the attractions. This picture shows the method of taking daylight pictures by means of a string running from a seat in a tree to a camera on the beach. Whenever a deer was passing within range of the camera a sharp whistle stopped it, and then a pull on the string recorded the scene. A number of such pictures appeared in the NATIONAL GEOGRAPHIC MAGAZINE for July, 1906. The figure of a deer may be discerned in the background.

familiar with it are fast departing or have never understood the unusual character of this migration when compared with the habits of the white-tail in its other widely separated ranges.

Early in May, as soon as the depth of the snow permitted travel, thousands of does worked their way north, traveling alone into a broad belt along the south shore of Lake Superior, where a few weeks later the fawns were born. The bucks came more leisurely, but by early June the migration was over.

On the coming of the first heavy north winds, accompanied by a light frost, sometimes as early as August 15, the does, fawns, and yearlings started south, and by September thousands were on their way, regardless of the fact that no snow would fall for six weeks and none deep enough to interfere with the food supply or freedom of movement for more than three months later.

In October most of the bucks had gone, and I well remember my old guide, Jake Brown, who for many years wintered in the vicinity of my camp, telling me, on more than one occasion, that if he "didn't get his venison under the snow by Thanksgiving Day" he "would not have a chance again before the middle of May."

In a few instances it was known that deer yarded, trying to winter near the lake; but they were promptly killed, either by the wolves or the Indians.

SNOW MAY HAVE CAUSED ORIGINAL
MIGRATION

Doubtless the great depth of snow in this region was the original cause of their fall migration, until it had finally become so fixed by inheritance that long before there was any apparent necessity the retirement took place. In twos and threes they traveled southerly on many trails



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HA
One of a group of four night pictures first establishing the beauty



Photograph by George Shiras, 3d

! accuracy of the camera and flashlight in big-game photography.



Photograph by George Shiras, 3d

THE FIRST SUCCESSFUL FLASHLIGHT OF A WILD ANIMAL EVER MADE

This yearling buck, with head erect and facing the jack-light, was the first satisfactory subject for a picture obtained by the author in his invention and development of night photography (see pages 175-176).

which by centuries of use had become about two feet broad, clear of obstructions and deeply cut in banks and soft ground. In swamps they were like caribou trails in Newfoundland.

These migrating deer always traveled with the wind and never against it, and always in the daytime, usually between 7 and 4 o'clock. It is interesting to note how this compared with the migration of the caribou in Newfoundland, where I spent two seasons studying it. There, too, the cows, calves, and yearlings began

moving south about the 15th of August, but usually in bands of a dozen or more, followed by the large stags later, and, like the deer, they traveled in the daytime, but always against the wind except during severe weather, at the end of the season.

THE CARIBOU DEPENDS ON SCENT

It is characteristic of the caribou to depend upon scent rather than sight or hearing, and this is especially true of the Woodland caribou of Newfoundland, which,



Photograph by George Shiras, 3d

"INNOCENTS ABROAD"

A flashlight photograph of a doe and her twin fawns, taken from a canoe, on the eastern shore of Whitefish Lake, nearly thirty years ago. This picture, with the frontispiece and the two on pages 138-139, were the first to indicate the possibilities of the camera at night. The group mentioned was exhibited by the United States Government at the World's Fair, Paris, 1900, receiving the Gold Medal, and at the World's Fair, St. Louis, 1904, receiving the Grand Prize.

migrating south in bands, have learned, through generations of experience in this oldest of English colonies, that danger always lies ahead; for concealed along the line of the trans-island railroad or in the passageways between numerous lakes are hundreds of hunters, mostly erstwhile fishermen, out for their winter's meat, with here and there an English or American sportsman in search of an antlered trophy. Headed against the wind and in a more or less open country, the telltale scent gives warning a long distance in advance.

On the other hand, the white-tail deer, traveling south alone or with the offspring of the year, moving steadily, but cautiously through a wooded country, always depend upon the eye or ear for any danger in front, and, coming down the wind along nearly straight runways, are able to scent any foe approaching from the rear, be it man or wolf.

DEER EASILY SHOT AT THE RAILROAD CROSSING

My first information concerning this migration came shortly after reaching Lake Superior. On several occasions one of my hunting companions spoke of the annual visits each fall of his father and several friends to certain localities on the Northwestern Railroad between Negaunee and Escanaba, some thirty miles south of the town, where the deer crossed the tracks in large numbers on the coming of the first cold north winds.

The members of this party were more interested in fly fishing, but found it possible to shoot all the deer they wanted in a few days each fall, since they presented easy shots on crossing the track and could be transported all the way back by rail.

In 1874 I was asked to join this party, leaving when the wind turned to the north, about the middle of August, for in those days the hunting season opened on or before this date.

The camp was located behind a sand-dune at a station called Helena, where there was nothing to dignify its name except a switch and a section-house half a mile farther east. At this point the railroad cut through a number of hardwood ridges, with open and nearly dry swamps between them.

Some of the deer followed large runways in the timber, crossing the track where there were deep cuts, and others came at a trot through the swamps, where often they could be seen at a considerable distance. The hunting was almost equally good for forty miles, most of these deer passing between Little Lake and Maple Ridge, coming from that portion of Lake Superior between Marquette and the Pictured Rocks, points indicated on the map (page 114). A similar migration occurred west of Marquette and throughout northern Wisconsin.

SAVING A QUARRY FROM THE TRAIN

On the first hunt I was placed on the south side of the track at a deep cut, where a deer had to come down one bank and up the other; so I was advised to wait until it was crossing the track, when I would have a better chance.

I had been concealed in the little brush blind about half an hour when, diagonally up the track, I saw a deer come out of the forest and stand on a bank cleared of brush. Remembering the instructions, I waited with considerable anxiety for it to advance. Just then could be heard the rumble of an approaching train bound west, with empty ore cars for the mines, and the deer, too, noticing the sound, evidently hesitated to advance.

After a minute's delay it seemed certain the animal would turn back, for the train was in sight, less than a quarter of a mile away. So, taking careful aim, I fired. The deer, giving a tremendous jump, toppled over the bank, lying with its head and shoulders across the track. Seeing it would take quick action to reach the animal before the train mutilated it, I hurried, arriving none too soon, for the heavy engine passed just as the deer was pulled aside, the engineer excitedly waving his cap by way of congratulation.

A SURPRISED HUNTER

On one of the fall camps at Helena the wind shifted to the south the afternoon of the second day, and any likelihood of deer crossing the track depended upon the return of the colder winds.

Toward evening we were visited by a miner of Irish extraction, who carried an ancient and rusty weapon of uncertain



Photograph by George Shiras, 3d

MIDNIGHT REFLECTION

A flashlight of a feeding doe, showing indifference to the jack-light after watching it for a few minutes.



Photograph by George Shiras, 3d

A BIG SURPRISE FOR A LITTLE BUCK

This young animal fed toward the canoe, with its body partly concealed by the marsh vegetation; on raising its head at the edge of the reeds it was surprised to see the jack-light less than twelve feet away, and still more astonished when the flashlight exploded just in time to preserve the scene.



Photograph by George Shiras, 3d

THE FIRST FLASH, FOLLOWED A SECOND LATER BY ANOTHER, SHOWN ON OPPOSITE PAGE

caliber. He asked if he could borrow a headlight we had in camp, having been told by his companions that the only chance of getting a deer depended upon the use of such a light at night.

For nearly two miles along the railroad were deep ditches on either side, resulting from the removal of the earth for the road-bed when laid through the swamp. Throughout the summer these ditches were filled with many water plants liked by the deer. Both the local deer and those traveling south often came to the ditches after dark, where they could easily be shot by any one walking up and down the track with a headlight.

Having shot several deer before the wind changed and not caring for this method of hunting, except as a last resort, the light was prepared and the ambitious night hunter was instructed as to its use and told just how the shining eyes of a deer would look when reflecting the rays of the lantern.

Shortly after dark he started down the track. In the course of half an hour came a particularly heavy report, vindicating the aspirant's remark "that the gun was loaded with a handful of powder and another of slugs," and he "rather guessed it would lay out anything that came in the way."

After waiting several hours, we went to bed, wondering just what had happened.

A PET SLAIN IN THE SECTION-HOUSE

At daybreak the fly of the tent was jerked open, disclosing the bulky form of the section boss, who lived half a mile down the track. Thereupon he grimly asked, "Were you boys out under the light last night?" A unanimous and spontaneous response in the negative seemed to reassure him, for he remarked it was a fortunate thing, since the time had come when a graveyard should be started for fool hunters in this neighborhood.

Pressed for an explanation, he said that after his men had gone to bed, there came an explosion, sounding as if "Mogul No. 9 had busted her boilers." Investigation showed the entire lower sash of a window of the section-house had been blown to pieces, while in the middle of the floor lay Black Tom, their cat, in a mutilated condition, the slugs continuing their course into logs between the upper and lower bunks containing several peaceful sleepers.

On opening the door and looking out, they saw a headlight and some fellow hastily reloading his gun. Thereupon each had seized an axe or a crowbar and



Photograph by George Shiras, 3d

A DOUBLY-INTERRUPTED MEAL

These twin fawns, on finding a pile of cabbage leaves behind camp, considered themselves in rare luck, but as the head of one was lowered the thread running from the stick on the left to the tree on the right released the flashlight; then the flame of the powder burned a string, releasing a leaden weight connected by a string with another flashlight and camera, thus showing a peaceful scene during the first flash (see opposite page), and the efforts of the fawns to bound away in different directions just as the second flash exploded.

started toward their assailant, "using language common to those parts; but, hampered by bare feet, they were unable to overtake him, and when last seen he was headed in this direction, going strong."

"CHASED BY WILD INDIANS"

Without further explanation, we knew that our unfortunate visitor had seen the glowing eyes of the cat, as it sat on the window-sill, and at such distance the section-house could not be seen; so, very naturally, he fired, thinking the eyes were those of a deer. But what had become of him and our light was now the question.

Toward noon a stranger appeared, and, depositing the lantern by the tent, prepared to depart with only a bare greeting. This, however, did not suit our idea of the situation; so he was asked what had become of the man who borrowed the light. Thereupon he said that Pat had crawled into the tent during the night with a tale about "being chased up the track by a band of wild Indians brandishing tomahawks and spears," and if he

"had not been a sprinter they would have gotten his scalp." Furthermore, he said he intended taking the first ore train in the morning for the mines. Before leaving, however, he told how he had fired at a big pair of green eyes, following which came a crash and a chorus of war-whoops, and he added that this was all the deer hunting he needed for the remainder of his days.

THE END OF THE MIGRATION

As the number of hunters increased along the railroad each fall, scaffolds were built a little way to the north on some of the approaching runways, thus cutting off those lying in wait at the track and leading to many controversies.

On one occasion, when still hunting along a trail, I found the remains of an Indian deer fence running for half a mile to the southwest, showing that years before the Ojibways of the Lake Michigan shore had taken advantage of this migration.

It has always been well known that deer will not jump even a low obstruction



Photograph by George Shiras, 3d

CAUGHT ON THE JUMP

This animated scene was obtained by the deer firing a blank cartridge first, and as they bounded away a released weight discharged the flashlight. Note that the fawn has not yet acquired the quickness and agility of the adult deer.

if placed in the general direction they are traveling. Such a brush fence, when crossing a number of runways, leads all the migrating animals to a point where the Indian hunter could kill them readily, or when absent a pit covered with brush precipitated the animal to the bottom, in some instances impaled on sharp stakes.

In 1885, some twelve years after my first experience in hunting the migrating deer, I made what proved unexpectedly to be a last visit. On arriving at one of the favorite crossing places, a barbed-wire fence was found strung for miles, south of the track, and post-holes were ready on the opposite side. It was apparent at once that this double barrier would soon terminate the annual migration, and a winter home must thereafter be found along the inhospitable shores of Lake Superior.

Before putting up the tent, I took a position on a high bank, from which place I saw a deer crossing the track some distance above. I wondered which direction it would take when intercepted by the fence. In a short while the unfortunate animal came ambling along, looking for an opening to the south, when a bullet ended its career. Feeling that such hunting was unfair, I gathered my outfit together and left on the next train.

Thus ended the deer migration of many centuries. Today all the great runways are obliterated by bushes and fallen trees; but, contrary to expectation, the deer soon adjusted themselves to their permanent home on and near the south shores of the lake. While sometimes in great peril when the snows are deep or crusted, they have, on the whole, a safer place than their former winter retreats in the south, where a largely increased population would soon have taken a greater toll than the timber-wolf or the lawless hunter of the north.

FACTS AND FALLACIES ABOUT THE WHITE-TAIL

There has always been a tendency on the part of some, when describing the white-tail, to illustrate the text with heads bearing an extraordinary number of points, whereas this animal, like the elk, is the only other member of the deer family having a growth of antlers remarkably uniform in size, shape, and number of points.

Any with thirty to forty tines or half that number are simply freaks and no more typical of the white-tail than one with three legs or two tails. Several million bucks have been killed in the United States, Canada, and Mexico in the past

seventy-five years, and most of those of unusual size or marked eccentricities in growth have been saved; so that it would be strange if in this large total there were not several dozen having an abnormal number of points or some unusual malformation.

The yearling buck is called a "spike horn"; the second year the antler has two points and is Y-shaped, and on the third, fourth, and sometimes the fifth there is an additional prong, representing with fair accuracy the earlier years. Thereafter there is no means of estimating the age except by the size and massiveness of the beam, which becomes uncertain when a deer passes beyond its prime, for then there is usually a recession in the size and weight of the antlers.

The maximum number of points vary from four to five, according to the range. In the south they are usually "four-pointers"; in the north and southwest the largest bucks average five points, which may be considered the standard in the respective localities.

PECULIAR GROWTH OF ANTLERS NOT DUE TO INJURY WHEN YOUNG

Sometime it has been suggested that a head having a great cluster of tines or other abnormalities has resulted from an external injury during early growth, but this, too, is erroneous, for with hardly an exception a peculiarity in one antler is duplicated in the other; and, moreover, these persist year after year in the same animal; consequently the internal growth is of symmetrical formation and in no-wise affected by external causes.

Another fallacy—in fact, a double



Photograph by George Shiras, 3d

A RUFFED GROUSE THAT TOOK ITS OWN PICTURE

At the edge of a clearing a bunch of mountain-ash berries was hung on a maple sapling, with a thread running to the camera shutter. A little later a female grouse pressed against the thread, with the resultant picture.

one—is the belief of many that the variance often noticed in the color of the antlers is due to a stain when the velvet is supposedly rubbed off on saplings, those of resinous character staining one color and those with a different sap another color. Any such uniformity in results is impossible, and would only cause a temporary and limited discoloration.

But, what is more to the point, no member of the deer family removes the skin-covering, or so-called velvet, at the time or in the manner suggested, though occasionally a buck will use its forefeet for this purpose, or gently switch its antlers in the brush.

"HORNING" OF TREES A SEXUAL MANIFESTATION

The "horning" of a young tree evidences the beginning of the rutting season, being purely a sexual manifestation.



NORTH END OF GRAND ISLAND, THE WESTERLY TERMINUS OF THE PICTURED ROCKS

It was over this precipice the imported Newfoundland caribou were supposed to have met their fate when chased by a timber wolf (see page 181).
Note the human figures at the base of the cliff.

These trees are rubbed fully a month after the velvet has been shed, and some weeks before the does are responsive, or about October 15, in the Lake Superior district.

In the past ten years I have been in the Michigan forest during all that month, my notes showing that the first rubbed sapling was October 5, and in the nine other years the date averaged the middle of that month.

In rubbing the antlers on a sapling, the white-tail lowers the head until the nose comes within a couple of inches of the ground, and then, in a deliberate way, one beam is pressed against the tree, the friction removing the outer strip of bark for about sixteen inches, showing the fresh white streak of the inner wood. The tree, small as it is, is seldom girdled, indicating that the animal stands in one position.

CARIBOU AND ELK ATTACK TREES AS IMAGINARY RIVALS

The caribou and elk, however, often regard the tree as an imaginary rival, attacking it with considerable vigor. Once I saw a bull elk butt a lower branch of a heavy red cedar, and as the limb rebounded the animal received a stinging blow in the face; whereupon he charged with the full weight of the body, snapping off the limb with a report heard 200 yards away.

The does bear their fawns on the higher ground, between May 25 and June 25, or seven months after the rut, concealing their young in balsam or maple thickets, where the family group lingers until fall, being more open to attack by the illegal hunter than the bucks, who hide in the thick and almost impenetrable swamps.

On the coming of the heavier frosts, in early October, the bucks wander about in the night, rubbing the trees and pawing up the ground some weeks in advance of the mating season, which occurs between October 20 and November 20, shortly after which the antlers are discarded, usually between December 1 and January 15.

Contrary to general belief, the antlers are not for use in defense against predatory animals, like the wolf, for they are shed before the coming of the deep snows

and when open waters still offer an effective means of baffling pursuers. When chased thereafter a buck will make his final stand by facing the foe, rearing high and coming down with the sharp forefeet on any animal attacking from the front.

ANTLERS USED IN MOCK BATTLES

The antlers are, therefore, purely a sexual manifestation, being used freely in mock battles with a rival. These sometimes develop into a serious affray, and then death may come when the antlers are inextricably interlocked.

The larger bucks weigh between 200 and 300 pounds, and it has long appeared to me that those of upper Michigan, either by gradual evolution or survivorship, possess much longer limbs than any of the species elsewhere. Living permanently in a region of deeper snows, it would seem that the ones having the longest legs would get a better footing or be able more easily to leap over logs or windfalls when being driven by the timberwolf.

On the other hand, the deer of the lower Alleghany Mountains in the State of West Virginia seem to have unusually short legs, for in this region their only safe retreat from hounds or man are the dense laurel thickets, where many of the runways pass under gnarled limbs only a foot or two above the ground, so that the ones more likely to escape pursuit are those capable of entering the first thicket or passing from one to another.

HOW THE MICHIGAN LICENSE SYSTEM NEARLY EXTERMINATED THE DEER

As a step toward conserving the deer, the number that could be killed annually in 1895 was restricted in Michigan to five for each hunter, and the license bore five detachable coupons for use in tagging each carcass. In the opinion of all sportsmen, this new system was expected to be of the greatest future value.

Then occurred an extraordinary psychological influence, upsetting all calculations, and Marquette County well illustrated what happened throughout the Upper Peninsula. Heretofore about three hundred persons hunted deer annually in this county. When the first licenses were issued, the usual number

that had hunted previously applied for permits, but it was noticed these applications kept on increasing throughout the season, until they totaled 652, far exceeding any previous year.

From this it appeared the public got the idea the State had awarded each of its citizens five deer a year at a nominal cost for those thrifty enough to act.

NUMBER OF HUNTERS INCREASED BY LICENSE SYSTEM

The following season other influences directly traceable to the license system not only increased the number of hunters, but, to a disproportionate extent, the number of deer killed; for it was observed that persons who theretofore were content with a single deer, or when disappointed on a hunt gave up at once in disgust, now tried to kill their legal limit, going to the woods again and again in this endeavor, and were not above having others supply the missing number if unsuccessful.

This situation was further influenced by the newspapers containing many personal items to the effect that "John Doe has filled his license during the first week," or that "Richard Roe expects to do so on the next hunt," and other suggestive statements, making each licensee feel he was on trial as a sportsman and a possible subject of ridicule when returning empty handed. Moreover, the licenses, with their strips of coupons, were conspicuously displayed in factories, shops, and offices or on the street corners, until hundreds who never had the slightest idea of hunting deer joined the crowds on their way to the county clerk's office.

An examination of the following figures ought to prove of interest, especially in view of the fact that there was no increase of population in this county, but actually a small decline during the period indicated.

MARQUETTE COUNTY DEER LICENSES

Year.	Licenses issued.
1894.... (estimated)	300
1895.....	640
1896.....	813
1897.....	853
1898.....	950
1899.....	1,047
1900.....	1,306

1901.....	1,532
1902.....	1,749
1903.....	1,942
1904.....	2,060
1919.....	3,379

This extraordinary increase from about 300 before licenses were issued to more than 3,300 hunters in a single county seems to have no other explanation than the one given. The system has brought about the destruction in the State of more than two hundred thousand deer that would otherwise have escaped and has continued indefinitely a well-organized band of hunters.

However, the license system in vogue throughout the most of the country has been of greatest value, supplying each State with ample funds for preserving the game and in many other respects proving of inestimable service. It just so happened to have had the opposite effect with Michigan's one big-game animal.

TEN DOES WILL HAVE 1,510 DESCENDANTS IN TEN YEARS

The white-tail is the one big-game animal whose perpetuation means more to the sportsmen of the entire country than any other animal.

The first and foremost necessity is a buck law to protect the females and fawns in every State containing any antlered animal.* Just let it be understood that when a buck is shot the number for the following year is lessened by only one, whereas he who kills a young doe destroys, by a single shot, potentially 151 bucks and 151 does! For it has been shown, upon a strictly scientific basis and by an accurate mathematical calculation, that a doe and her descendants in a period of ten years, not counting out the natural casualties, will produce a total of 302 deer, and by the death of this ancestral mother the link is broken, with the irrevocable loss stated.

The same proportion holds true with a larger number, for ten does and their descendants will produce 1,510 bucks and 1,510 does, showing that when the female is protected more deer can be killed each year, beside leaving an increased number in the woods.

Such a result is not, after all, so mys-

* Twenty States have passed this law.



Photograph by George Shiras, 3d

WHITE FAWN FOUND IN 1916, WHEN A DAY OR TWO OLD

Reared in company with the red fawn. The usual row of white spots can be seen on the white body (see page 183).

terious, if we keep in mind the methods of reproduction applicable to domestic animals; for if a farmer had as many bulls as cows, as many roosters as hens, and killed them indiscriminately of sex, he would, of course, be classed as demented.

Just because our wild animals bear their young in remote thickets, we seem to think their maintenance is based upon a different method, and go on killing the females year in and out under the blind assumption that it can make no particular difference in the future supply, whereas it represents the difference between extinction and perpetuation.

In my boyhood days it is doubtful if there were a thousand deer in the wilder portions of Pennsylvania. Last year 3,000 bucks were killed in that State, and this number will increase steadily, the only limitation being a sufficient area to sustain such a multiplication of the species. But in this State, like New York and Vermont, the second growth in rough and mountainous portions has been

restocked with game and properly safeguarded, showing how the older localities have already taken advantage of the favorable change in environment (see page 204).

CHAPTER IV

THE SUDDEN DISAPPEARANCE OF THE PASSENGER PIGEON IS THE GREATEST OF ALL BIRD MYSTERIES

The final stand of the passenger pigeon was made in northern Michigan, Wisconsin, and western Ontario, and in this general locality I witnessed the demise of a once countless species. Gradually the flocks had been driven from their haunts in the Atlantic coast states and about the Ohio Valley, but from the time I first went to Lake Superior to the date of their sudden disappearance, the wild pigeon seemed to be present each season in its usual abundance.

For a species that far exceeded any other game bird, a gradual decrease



Photograph by George Shiras, 3d

THE ANCESTOR OF THE ALBINO DEER HERD OF GRAND ISLAND

Observed first in 1912; killed by a pot-hunter in 1914, when about seven years of age. Body mounted as above. Spread of antlers, 2 feet 2 inches; weight, 150 pounds. It has had nine white descendants so far (see page 182).

might be attributed to several reasons apart from the various and continuous methods of destruction, namely: the range was always east of the Great Plains, thereby permitting concentrated hunting in the more accessible regions. Furthermore, each pair had but one young, in contrast to the domestic pigeon, with double the number. However, their unexpected and inexplicable extinction in, perhaps, a single season constitutes the greatest of all ornithological mysteries.

The birds came in vast flocks to Lake Superior in May, and before colonizing for nesting they were killed by natives, who fired into the passing flocks as they swept low along the shores, this being the only period when wing-shooting was indulged in.

After the birds had selected a breeding place, usually in the same locality each year, the slaughter began; for, besides the local hunters, the professional trappers were quickly notified of any gathering

place, and were soon on hand netting or killing these birds by the thousands for the eastern market, besides shipping them alive in crates for trap-shooting tournaments.

BIRDS SLAUGHTERED BY FIRELIGHT

I never attended any of the holocausts at the breeding places, for such they often were, since circular fires were built around the roosts after all the birds had assembled for the night, and in the confusion of the smoke and flames they were beaten down and destroyed in the most relentless manner.

About the middle of July the survivors, with their young, dispersed over much of the surrounding country, gathering particularly about huckleberry plains and burnt-over districts, where ground food—huckleberries, alder-berries, wild cherries, and service-berries—were abundant.

After the wild fruits were gone many



Photograph by George Shiras, 3d

FIRST ALBINO FAWN, AT THE AGE OF THREE YEARS, IN ITS SUMMER COAT, WHEN THE PINK SKIN SHOWS PLAINLY THROUGH THE THIN, WHITE HAIR (SEE P. 185)

flocks moved into Canada, where a later berry season was the attraction, and by October all departed for the south, unless a heavy crop of beechnuts led some to linger.

It was in August, 1885, that I made the usual trip to some large plains covered with huckleberries, ten miles up the shore from Marquette and inland about a mile, where it was my custom to kill, once a year, a large number of pigeons for distribution among friends. Such an expedition differs from the ones where shooting was limited to a few for camp use.

Selecting the young, so readily told by the immature plumage, it took only a few hours to accomplish my quest. At this time the birds were in their usual numbers, and I returned under the belief the wild pigeon would continue for many years in this region.

BIRDS SUDDENLY VANISH

The next season I saw a single bird; but, like the rest of the hunters, concluded that for some unforeseen reason the pigeons had gone elsewhere and would surely return the following year.

But not one, to my knowledge, has been seen since along the Lake Superior shores.

When the unfortunate history of this bird is examined, it is not hard to see that it was doomed because it was a migrant. The rule in each State was to have an open season when such migrants were present and a closed season, if any, after they had gone. This meant, of course, continuous shooting throughout the year.

In 1857 the Ohio legislature enacted a law protecting local game birds, and the committee report gave as a reason for not including the wild pigeon the following:

The passenger pigeon needs no protection. Wonderfully prolific, having the vast forests of the north as its breeding grounds, traveling hundreds of miles in search of food, it is here today and elsewhere tomorrow, and no ordinary destruction can lessen them or be missed from the myriads that are yearly produced.

The fact that migrant game birds, above all others, needed protection was not seen at that time, and not until long afterward, when the passage of the Federal migratory bird law made possible an



Photograph by George Shiras, 3d

SECOND WHITE FAWN AND THE NORMALLY COLORED MOTHER

Both are wild and unapproachable (see page 183).

adjustment of the open seasons throughout the country consistent with the protection of this class of birds.*

An epidemic or some convulsion of the elements, such as an offshore gale, with the clouds raining down heavy hailstones, may have accounted for their sudden disappearance, but from information available one can only guess as to the immediate cause which brought about their untimely end.

RUFFED GROUSE MOST HIGHLY ESTEEMED OF UPLAND BIRDS

The most highly esteemed game bird of the northern uplands, whether for sport or the table, is the ruffed grouse. Clothed in rich gradations of brown or gray, the neck encircled by a ruff of iridescent black, erect in figure, with a sweeping fan-like tail, its presence is often disclosed by a sudden whirr and a meteoric flight, startling even to the expectant hunter or the trailing fox.

With the extinction of the passenger pigeon, once so numerous about Lake

Superior, and the rarity with which shore birds or wild fowl venture across broad waters with unsighted shores, the perpetuation of the ruffed grouse as the sole resident game bird of the region becomes unusually important.

On my first camping trips the grouse were found in many clearings, second-growth thickets, and about old lumber roads; for berries, insects, seeds, and sunlight induced such gatherings. For years I was under the impression that this bird

was well distributed and numerous. Later I found that in the main forests and in localities where water was distant more than a quarter of a mile scarcely a grouse could be seen, except when midwinter drove them into the heavier timber.

After the local hunters increased tenfold and the automobile gave access to the more remote places, the grouse of upper Michigan declined to a point where extinction was imminent and appeared certain when two cold, wet springs occurred and hardly a young bird survived.

A REMARKABLE INCREASE IN BIRDS

In 1917 the legislature closed the season for two years, and the result exceeded all expectations. The ensuing year showed a great many scattered coveys, and the next they more than doubled, while in the spring and summer preceding the open season the birds were found in numbers never known before in the history of the country, automobiles being stopped frequently by birds dusting themselves in the woodland roads.

With a daily limit of five birds and a total of 25 for the season, one might have supposed that the number killed would hardly have equaled the best years of the earlier days. But they were brought in the first day by the hundreds, by thousands the next week, and then by tens of thousands, exceeding a total of one hundred thousand in the shortest season.

* Mr. Shiras has refrained from stating that in 1904, when a member of Congress, he was the author of the original migratory bird bill, the later enactment of which has insured not only the perpetuation of our wild fowl and insectivorous birds, but has already led to a greatly increased number. This measure is generally regarded as the most important game legislation that has been passed by State or nation.—EDITOR.

In Minnesota in 1920, under a similar closed season, but with larger bag limits, the kill was unparalleled, with a total exceeding 500,000 grouse.

THE GROUSE THRIVED IN CLEARINGS

Many might naturally think that this wonderful increase was wholly due to the previous closed seasons. While undoubtedly making such a showing possible, in the writer's opinion the result was primarily due to another distinct and, fortunately, permanent cause, namely, a gradual and favorable change in environment during some thirty years preceding.

By reason of overshooting and unfavorable weather, the grouse of Michigan, Wisconsin, Minnesota, and western Ontario had been greatly reduced, only a scattered bird being found here and there. With a two years' closed season the remnant had an opportunity to establish itself in the thousands of clearings where few birds had ever had a chance before. The fact that one pair and their offspring would produce some 200 birds during the period they were thus protected indicates how the grouse was able to spread quickly through the entire region.

BIRDS NOW SHOT ON THE WING

The daily limit of five birds has resulted in a new form of sport in northern Michigan. Accustomed in this region to killing the grouse on the ground or in the trees, the hunters soon found the limit of five birds might be reached shortly after discovering a well-filled covey, and the day's sport ended in a moment. Therefore, for the first time, many began shooting on the wing, using thousands of shells without much damage to the fleeing birds, but greatly expanding the day's sport.

"A dead bird tells no tales," but the many survivors of this aerial bombard-



Photograph by George Shiras, 3d

SAME WHITE FAWN AND COMPANION IN FALL, WHEN EACH
HAS LOST THE WHITE SPOTS (SEE PAGE 183)

ment have received a greater education regarding the use of gun than any of their predecessors, many finally acquiring the alertness and caution of the grouse of the Eastern coverts.

PECULIAR HABITS OF THE GROUSE

In the temperate months the grouse has an excellent choice of food, consisting of a great variety of berries, small fruit, seeds, buds, clover, beechnuts, grasshoppers, and a multitude of young, tender leaves. In the winter one wonders at their survival; for now the fall flight of the robins completely exhausts the berries, which were wont to linger and ripen well into winter, compelling the grouse to depend largely upon yellow birch buds, with many a forced meal on an evergreen.

Fortunately, whenever the temperature is far below zero the sky is usually clear and the grouse are active and unconcerned, but if the days and nights are dark and cold or the air filled with merciless pellets, they have the habit of plunging from a higher branch head foremost into deep snowdrifts, where a foot below the surface the heat and weight of the body form a globular retreat, in which they remain comfortably until the storm clears or hunger forces an exit.

Once when seated in a tree watching for deer, several days after the conclusion



Photograph by George Shiras, 3d

SECOND ALBINO BUCK, CAPTURED IN 1915, WHEN THREE YEARS OLD; WEIGHT, 160 POUNDS

Shown above with three normal deer and fawn. Antlers each year in the form of long spikes, with one forked. Note white velvet on the growing antlers (see page 185).

of a heavy snowstorm, I saw what looked like a small mouse at the base of a maple tree, and then this dark object elongated into the head and neck of a grouse. Finding the weather to its taste, it emerged, clucking and spreading its tail before taking flight for a repast upon the swollen buds of a near-by birch.

Many years later, while hunting the varying hare, just as a blizzard came sweeping in from Lake Superior, I saw the swift descent of a dark body from a tree ahead and a slight disturbance in the snow. Noticing a grouse in the same tree, I knew its companion had sought warmth and protection in the coverlet below and I withdrew without disturbing either.

Sometimes in winter or the early spring there may come a rain or a warm day that melts the surface snow, followed by severe weather, and then thousands of grouse are imprisoned and the heretofore

safe retreat becomes their tomb, should weeks pass by before the seal is broken.

CHAPTER V

EXTRAORDINARY CATCH OF LAKE TROUT WITH TROLLING LINES

In 1872, when 12 years old, I had an early introduction to lake trout. A report was brought to Marquette by a lumber-laden schooner, becalmed for a while in the vicinity of Stannards Rock, a sandstone reef lying a few feet below the surface, some forty-five miles northwest of the town, that the waters about the reef were surrounded by immense schools of lake trout. It was said that the fish could be hauled aboard the schooner by simply casting a trolling spoon overboard, when there was such a rush by the fish that one could imagine it was a contest to see which one might be caught first.

An enterprising captain of a local ex-



Photograph by George Shiras, 3d

WHITE BUCK WITH A MIXED HAREM OF WHITE AND RED DOES

This buck never recovered from the shock of its capture, remaining wild and lame (see page 182).

cursion steamer thereupon advertised an expedition to this vicinity, and about seventy-five persons, including women and children, departed under bright skies and unruffled waters. At noon the dangerous reef was approached cautiously, and the steamer anchored in about thirty feet of water.

Soon ten boats were lowered over the side, each expectant fisherman having a trolling line, as many as four or five lines trailing behind each boat. In a few minutes there was a rush of eager fish, and to my youthful mind there never were such scenes of excitement, for as the boats circled about the reef the long lines were diverted at various angles by the larger fish, becoming entangled, while the continued flopping of those captured caused the women and children to shriek in triumph or dismay.

Several times I had on a fish weighing over twenty-five pounds, which only with the aid of stronger arms could be lifted free of the water. In one instance a spoon that became detached was cast

overboard and a near-by fish bolted it and went off in triumph! In several cases tin-tipped oar-blades were seized, so anxious were the fish to try anything having a resemblance to living prey.

In less than three hours a thousand fish were taken, averaging ten pounds, and then this riot of destruction came to an end, for it finally became apparent how difficult it would be to give away five tons of trout among the friends and neighbors of the participants.

The results of this expedition soon reached the ears of the local fishermen, and for several succeeding seasons immense catches were made. Now a towering lighthouse surmounts this rock as a warning to the mariner and a fitting monument to the myriad of fish that have long since passed away.

AN IMPROVISED COOKING OUTFIT

On one of my earliest camping trips for speckled trout, with old Jack as guide, we rowed about three miles when it was discovered that the box containing the



Photograph by George Shiras, 3d

A PIG-LIKE ALBINO BUCK AND TWO WHITE FAWNS: GRAND ISLAND (SEE PAGE 182)

cooking outfit had been left behind. Naturally, I suggested returning for it; but Jack promptly said it would bring bad luck to do this after once having made the start, and, besides, with our pocket-knives it was easy to make what was needed.

In about three hours Shot Point was reached, the first rocks to the east, where I began fishing, leaving Jack to put up the tent and start the fire.

MAKING A FRYING PAN FROM A CAN

On returning with a creel of trout, I found Jack had already replaced the missing outfit. From large sheets of birch bark he had fashioned plates, while cups and other containers were made of the same material, with knives from hardwood and forks of double-jointed twigs. In the fire was a can of tomatoes perforated in the top to let out the steam, while well beneath the glowing coals half a dozen potatoes were baking. Alongside he placed the dressed trout, wrapped in wet, brown paper. Then the tomato can was emptied into a birch-bark dish before the fire, and with a piece of wire a bail

was made for it, and soon the tea was boiling.

At the next meal, after heating a can of beans and removing the contents, it was cut and flattened into a frying-pan, with a handle made of a split stick, serving thereafter for frying trout or bacon and the all-important flapjacks.

On suggesting to Jack that several of these fireside conveniences depended upon having canned goods, he thereupon picked up a small boulder and explained that, after heating several of these in the coals, by putting them into the birch-bark bowl one could brew tea, make soup, boil fish, or have a stew.

This was my first lesson in the ease with which supposed essentials might be left behind, proving a useful experience when forced to travel light, or a capsized canoe sent the outfit to the bottom.

THE SPECKLED TROUT OF LAKE SUPERIOR

Prior to 1890 the range of the speckled trout included all of the shore waters for more than a thousand miles, except in places where sand beaches lacked coarse gravel or boulders, or continuous cliffs

made the steady surge of the receding waves an unsuitable location for a fish particularly disliking turbid or unsheltered waters.

Every tributary stream contained trout as the permanent and almost sole occupants, with the temporary addition of all in the lake during the spawning season, unless flowing from headwater lakes, in which case the higher temperature and the existence of pickerel or bass discouraged their presence.

Consequently, good fishing was within easy reach of every settlement and camping place, the trout occupying a narrow strip within 50 feet of the shore or nearby islets and reefs, for beyond were the giant lake trout, which, while respecting absolutely the riparian rights of their more aristocratic kin, allowed no trespass in their own domain.

On the other hand, just to the east, Lake Huron, including Georgian Bay and the southern portion of Ontario, contained no speckled trout except in an isolated case or two, for bass, pickerel, pike, and land-locked salmon abounded, the less abrupt watersheds favoring chains of lakes with sluggish, interconnecting streams of a high temperature in summer.

A TROUT FISHER OF 70 YEARS AGO

In 1849 the paternal grandfather of the writer first came to Lake Superior, intent solely on trout fishing, having heard from pioneer business friends of the beauty and healthfulness of the region and the wonderful trout fishing. At the time of his earlier visits it was necessary to transfer around the Sault rapids, taking a small steamer that had been assembled beyond, when visiting any of the few settlements on Lake Superior.

To one who had fished only the brook trout of the Alleghany Mountains, the size, brilliancy, and activity of those in the lake were in striking contrast, and in the long period following he seldom visited any stream, for the smaller fish and their ease of capture did not appeal to him.

Accustomed to making his own bamboo rods, flies, dip-nets, or seines for catching minnows, he either fished from a little rowboat, anchored in a suitable location, or from some of the many points



Photograph by George Shiras, 3d

ALBINO DOE IN HEAVY WINTER COAT

She was brought from southern Michigan in 1918; eyes pink and very susceptible to light; hoofs and nostrils white (see page 183).

separating bays, where there was a steady movement of the larger trout.

It seems worthy of mention that family records covering 65 years, and supplemented by other contemporaneous data, showed that the maximum weight of any trout taken was 5½ pounds, the average of the larger ones ranging from 4 to 4½ pounds (see page 131).

On the northern, or Canadian, shore the larger fish averaged about a pound less in weight, except in the Nipigon River, where specimens reaching ten pounds were not unusual.

Now that the trout along the southern shore are approaching extinction, a tragedy assured by the improvident custom of catching the remnant at the mouths of spawning streams, it is rather surprising to learn that occasionally a fish is taken weighing 6½ pounds, the explanation be-



Photograph by George Shiras, 3d

THE THREE ADULT ALBINO DOES UPON WHICH THE PERPETUATION OF THE HERD
LARGELY DEPENDS (SEE PAGE 185)

The eyes of two are light gray, and the other red, in striking contrast to the black eyes of the normal deer.

ing the greater proportion of food for the few survivors.

INTRODUCTION OF THE ANGLEWORM ON LAKE SUPERIOR

The hooks used by this ancestral fisherman were long, slender, and slightly curved, allowing the tying on of different feathers well up on the shank, and including almost invariably a strip of red flannel or a piece of similarly colored yarn, beneath which was room for one or two large angleworms. In those days the use of live bait, and especially angleworms, was regarded as sportsmanlike, and apparently justified in the case mentioned, for the fish sought were those lying deep below the surface, on a rocky bottom. To hook these big fellows was only an incident in the long, hard contest with a slender rod.

Every spring, and while the angleworms were still near the surface, small boys were engaged to dig an ample supply in the vicinity of Pittsburgh, and

these were taken in a two-gallon can to Lake Superior, where they were placed in a large wooden box filled with black earth and protected against a too-miscellaneous use by lock and key, for the angleworm was not to be found anywhere along the entire lake or adjoining territory. Toward the close of each season the remainder, if any, was distributed among eager applicants, and finally found an end within the gullet of equally eager trout.

"A SERPENT OF DISSENSION"

How this apparently harmless earthworm became a miniature serpent of dissension happened once when the surplus was turned over to an elder of a village church, with directions to apportion the supply equally among his associates. Some time later word came that a great row had developed over their distribution, followed by a secession of a part of the congregation and the building of another edifice.



Photograph by George Shiras, 3d

AUTHOR'S CAMP, ST. IGNACE ISLAND, NORTH SHORE, ONTARIO

Here the tents faced 160 miles of open water, where many medium-sized trout were taken within a hundred yards, but most of the larger ones became the victims of a gill net extending to the shore, ostensibly set for lake trout of the deeper waters (see page 187).

This ancient fisherman was never able to determine satisfactorily whether he was to blame for such a breach or was to be congratulated on having brought about the establishment of two churches where there had only been one before.

In 1878, on receiving a larger remnant of angleworms than usual, I planted them in the neighborhood, with the hope that in a short while the local supply would meet future demands. At the end of three years they became very abundant in this little preserve; so some were taken to Whitefish Lake and placed in rich, deep soil near old Jack's cabin. These grew to extraordinary size and far exceeded their Pennsylvania progenitors. Some reached the headwaters of near-by streams and were carried down each spring, until most of the region showed their presence.

THE ROBIN BENEFITS BY THE ANGLE-
WORM'S INTRODUCTION

Meanwhile Marquette had become a systematic point of redistribution, and for a considerable time the angleworm has been found scattered along the entire

south shore and at either end of the lake, there still being about 150 miles in the central portion of the north shore where I have neither seen nor heard of their presence.

If the fly fishermen are no longer concerned about the coming of the angleworm, the history of their naturalization may prove of interest to the scientist.

The robin, however, is still a beneficiary, for these worms constitute their chief diet in May and June, before the coming of the berries, and are the sole food of their first brood. Moreover, it has been noticed in the last decade that the woodcock, which once stopped briefly on their migratory flight, now linger for weeks in the alder thickets near the streams where they can always find a bountiful supply.

The gardener, too, has found a friend in this little borer, for they assist in the breaking up and enrichment of the surface soil, as the casts of this active feeder contribute much toward the quality and fruitfulness of the garden patch.

The angler and commercial fisherman, together with a large part of the public,



Photograph by George Shiras, 3d

LARGE BULL MOOSE AT A SALT SPRING ON ST. IGNACE ISLAND

The saline waters came from beneath a red sandstone stratum a few hundred yards behind the camp (see page 188).

are interested in maintaining a bountiful supply of fish, high in quality and reasonable in price, justifying their support of an effort now being made to rehabilitate the fisheries of the Great Lakes.

The recent introduction of the steel-head salmon has added another fine and adaptable fish, which, spawning in the spring, can utilize the streams for this purpose, and when unoccupied by the brooding trout in the fall.

THE SPECKLED TROUT IN DANGER OF EXTERMINATION

The species found in Lake Superior are limited in number, for the depth and purity of its water and the low temperature throughout the year have barred the coarser and less desirable kinds.

At one time the speckled trout, the lake, or so-called Mackinaw, trout, and the whitefish were present in extraordinary numbers, each occupying a somewhat different portion of the lake, according to the depth and character of the

water, and all living in comparative harmony. The speckled trout depended upon minnows, insects, and crustaceans near the shore, the lake trout had an ample supply of herring, while the whitefish, a bottom feeder, in nowise interfered with the others.

There was a hardly appreciable decline in the speckled trout during the fifty years herein recorded, until it was unfortunately discovered, that during the month of August all the trout living in the lake congregated in particular streams for spawning, and these localities were then visited by an increasing number, some fishermen taking in a single day a hundred pounds of sluggish and inactive fish and often salting down the surplus for winter use.

In this onslaught others reluctantly joined; for, as the fishing became poorer each season in the open waters, they yielded on the theory that if the end were approaching, one might as well have a share in the final distribution.



Photograph by George Shiras, 3d

A COW MOOSE AT THE SAME SPRING

Here a bull moose had been illegally killed by natives just before the party's arrival and its festering body soon drove the other animals away (see page 188).

The prompt termination of this indefensible practice, and the equally bad one of running gill nets to the shore, would in a very few years restore the finest of fresh-water game fish to approximately their former numbers.

WHITEFISH FISHING WANES AS HERRING INCREASES

The whitefish, especially those of Lake Superior, have been generally esteemed as the most delicious of all fresh-water species, and when the nets were few and far apart and the methods of transportation and distribution unsatisfactory, millions of pounds were taken each season, while today, with a hundred times greater number of nets, a much higher market price, and rapid means of distribution, but a fraction is caught.

The following figures, furnished by the U. S. Bureau of Fisheries, tell the story: Whitefish, 1885, 8,000,000 pounds; 1918, 300,000 pounds. Thus it is apparent that this excellent fish is commercially extinct, but with a sufficient remnant left, if protected for a while, to be restored in waters always favorable for their support.

At one time the lake trout were in little demand, for the whitefish dominated the western markets, yet even then, with a few nets set, the annual catch approached 3,000,000 pounds, so abundant were they everywhere in Lake Superior.

The fishermen of Michigan, Wisconsin, Minnesota, and western Ontario now use sail-boats, launches and tugs for gathering the daily catch, setting gill and pound nets in all parts of the lake, sometimes two hundred feet below the surface, while larger steamers collect those taken in the more remote localities.

A DOUBLE DISASTER

Notwithstanding such a combination of efforts, the present total does not equal the number so readily taken forty years ago, with the result that the proportionately greater expenses could not now be met were it not for the extraordinary number of herring taken each fall, and these figures are significant: Herring, 1885, 300,000 pounds; 1918, 8,000,000 pounds, showing how this small and much inferior species has exchanged places with the whitefish in precisely the same period.

The present rapid consumption of the herring has become doubly disastrous, for it helps financially in maintaining the fishing fleet during their concluding attack on the lake trout, and then, with the herring gone, any future effort to restore the lake trout becomes increasingly difficult, as the latter's main food supply is thus destroyed.

Would it be possible to imagine conditions better adapted for the permanent exhaustion of the game and commercial fish in the finest and largest lake in the world?

It has long been recognized that the lack of coöperation on the part of the States and Canadian provinces bordering on the Great Lakes accounts for this situation. With each acting separately and each naturally disposed to have laws equally liberal toward their local fishermen, it follows that the State or Province spending the least money in fish culture, or having the most improvident regulations and the least efficient system of enforcement, sets the pace for the others, while the governments of each country must sit supinely by, because lacking any authorized jurisdiction over international waters in which their respective citizens have a common interest.

CANADA WILLING TO REVIVE THE TREATY

It was to meet this unfortunate situation that the United States and Great Britain negotiated and ratified a boundary waters fishery treaty, but in 1914 failure of the U. S. House of Representatives to pass an enabling act, on account of minor differences of fishermen in southern Michigan and jealousy over the proposed withdrawal of local regulations, has postponed indefinitely the operation of this beneficent agreement.

It is understood that Canada is still willing to see the treaty revived by the passage of appropriate legislation if our country will now make a move in this direction.

By such coördination of authority and coöperation in activities, the problem can be readily solved; for it is not a local question in any sense, but one that is interstate, national and international in scope.

That such a conclusion is reasonable

and not speculative has already been established by the Migratory Bird Treaty, under the recent operation of which our wild-fowl are being rapidly replenished, and the more valuable insectivorous birds protected permanently in behalf of the agricultural interests of each nation.

CHAPTER VI

THE TIMBER-WOLF AN ANIMAL, OFTEN MISREPRESENTED

From nearly every standpoint, the timber-wolf is an interesting animal, the only drawback to gaining an intimate knowledge of its habits being the extreme difficulty in finding any range where it may be successfully studied; for to a large extent its habits must be inferentially determined, this prowler of the night seldom coming under direct observation.

No animal possesses greater sagacity in avoiding its only enemy, man, and few show greater cunning and persistence in seeking their prey. If I were to be asked to give a predominating characteristic of the gray wolf, it would be its fear of man. Accustomed from our early childhood to hear of its savage nature, and seeing frequently in the press the harrowing accounts of men being pursued by these bloodthirsty creatures and escaping only by nimbleness in ascending a tree or perhaps by barricading a wilderness cabin, so conveniently at hand in such stories, it is not strange that in the popular mind the timber-wolf is still regarded as the arch enemy of man. But there is the best of proof to show that man has thoroughly terrorized this animal.

TWO GREAT CONTRASTS: THE WOLF AND THE DOG

The wolf and its descendant, the dog, present the greatest contrast in their respective attitudes toward man. One is distrustful and cunning, skulking in the shadows of the night, intent upon rending to pieces any less powerful animal, but having a dread of man so overpowering that they often die of their overexertion in desperate efforts to escape within a few hours after being trapped; and the other affectionate, loyal beyond comparison, intent upon faithfully performing



TWO PAIRS OF MOOSE ANTLERS INTERLOCKED

Each of fifty inches spread, inextricably joined in the deadly rivalry of the mating season, where both contestants were vanquished forever. Found near the center of St. Ignace Island (see page 188).

every service as a companion or assistant in the labors or pleasures of the day, representing the highest and most intelligent response to kindly treatment. Reversion from dog to wolf begins under a cruel master or when half starved and ill-treated by the many barbaric tribes employing the dog as a mere beast of burden.

The wolf has had every occasion to fear his human foe, for it has been trapped, poisoned, snared, shot, harassed by hounds, and a price placed upon its head. The survivors know that however much

the other animals of the forest may stand in awe of them, man is ever their relentless and successful enemy, and only by the exercise of all their highly developed senses can they hope to escape the same miserable death they so ruthlessly inflict upon their prey.

THE COURAGE AND FEROCITY OF THE WOLF GREATLY EXAGGERATED

In the years spent in some of their many ranges on the northern continent, I have never seen more than twenty wolves,



IT REQUIRED THREE PADDLERS TO KEEP ABREAST OF THIS STURDY SWIMMER
Who was feeding on water plants eight feet below the surface when disturbed by our
approach (see page 188).



BREAKING THE SPEED LIMITS!

Photographs by Paul Swift

Same bull approaching the shore. Both pictures were taken with a small hand camera by one of the anglers of the party, showing what can sometimes be accomplished with a small instrument.



Photograph by George Shiras, 3d

A BEAUTIFUL LAKE ON ST. IGNACE ISLAND

This lake, four miles long and nearly dividing the island, is the largest of some fifty ponds and lakes. The western shores are high and rocky and the eastern low, with shallow bays, where forty moose were seen in two days. Many of the animals feed on the water plants, six feet below the surface. While the forests look dense, all the lower limbs have been eaten by the moose (see page 187).

although hearing them howl upon hundreds of occasions and seeing their tracks in every direction.

Northern Michigan was, and still is, one of the favorite resorts of the timber-wolf, owing to the dense forests and the abundance of deer and rabbits. Here I have shot a few and trapped or poisoned a dozen or so about the camp, a favorable record, considering that of the myriad of hunters roaming this section every fall, many of them, in more than half a century of hunting, have yet to see or kill their first wolf, although they number thousands about Lake Superior (see page 133).

Nowhere in America have I ever been able to get an authentic account of a man being deliberately pursued or injured by a wolf, although out of the multitude of such stories it may be that one or two are true, for the possibility always exists of an individual animal lacking the caution of its forebears or where living in a totally uninhabited country it has not inherited any suspicions of man.

Probably the most conclusive proof of the wolf's fear of a human being is the fact that every season thousands of deer carcasses in the Lake region are left over night on the ground or hung from a branch within reach, and yet are undisturbed because of the slight scent left by the hunter. Even the entrails remain untouched until all human trace has disappeared.

A WOLF SHUNS A DEER THAT MAN HAS TOUCHED

Venison is the principal diet of the Lake Superior timber-wolf, for they think and dream about it from puppyhood days, yet these keen-nosed creatures, when the air is filled with bloody odors, refrain from touching the unguarded carcasses. This should convince the most skeptical that such an animal on detecting the presence of a traveler in the woods is not likely to attack him in the flesh, since it shrinks in terror whenever discovering anything indicating human scent about a slain deer.



Photograph by George Shiras, 3d

NIGHT PICTURE OF A COW MOOSE TAKEN BY SET CAMERA AND FLASHLIGHT

This basin of clay, impregnated with salt, had been eaten five feet below the surface. Note absence of lower branches (see page 187). A quantitative analysis of the water showed: calcium oxide, 376 parts; magnesium oxide, 22; potassium chloride, 17; sodium, 615; total chlorine, 576 parts.

Such fictitious tales never come from reliable sportsmen or from experienced trappers, but are circulated by lumberjacks, land-lookers, homesteaders, inexperienced hunters, and by sensational writers, unable to tell the difference between the hoot of an owl or the cry of a loon from that of a wolf, and, besides, are ever prone to imagine or enlarge upon the supposed perils of the forest.

Twice, however, I have had a carcass of a deer eaten by wolves when left out overnight—once where the animal was shot across a small lake and I did not go to it until morning, when I found only a few scattered remnants, and again, when trailing a wounded buck in the snow, the search was suspended at dusk, and on renewing it the next morning I found several wolves ahead, but beyond where I had stopped the night before. In a few minutes there came in view the blood-stained snow, and only the bones stripped of flesh remained. In both instances there was, of course, no trace of

human scent, so the wolves had no hesitation in devouring the carcass.

A WOLF THAT DIED OF FRIGHT

On one occasion, many years ago, wolf tracks were seen on the sand beach at the end of Whitefish Lake; so a large steel trap was set in the water of the creek where a deer runway crossed it, and the same night I heard a wolf howling in that direction.

In the morning, on entering the slough, I fired at a pair of black-ducks passing overhead, and on reaching the place where the trap had been set, found it gone, some of the alders in the vicinity being uprooted, caused by the temporary catching of the clog. Upon reaching the opposite bank I found other alders had been torn to shreds, many of them still dripping with blood from the torn mouth of the wolf as it frantically tried to escape.

Believing a rifle might be needed in the more open ground, where the clog



Photograph by George Shiras, 3d

VIEW OF AUTHOR'S CAMP FROM THE SWIMMING POOL: WHITEFISH RIVER

The pictures of deer and other animals in the garden were taken between the two upper buildings shown on either extreme, while the beaver, muskrats, mink, and raccoons, as well as some deer, entered by the river front (see pages 188-193).

could be dragged readily, I returned to the camp for one. Taking up the hunt again, I soon noticed a large wolf lying on the ground with its head between its paws, almost as if asleep. On approaching the animal it was found to be dead, its body still warm.

It had probably been held fast by the clog when it heard the shot fired at the ducks, which accounted for the bloody alders, as the animal frantically renewed its efforts to escape. On reaching the hilltop the accumulating terror of its position undoubtedly resulted in death.

THIS WOLF COLLAPSED WHILE BEING
PHOTOGRAPHED

That this instance is not exceptional was proved three years later in the same locality, where a wolf was trapped one night and again it howled. On the following morning, with rifle and camera, I visited the spot. The trap was missing, but the animal had not gone more than twenty yards when the log attached to the chain caught, and as I approached, the wolf raised itself to a sitting position. While I was clearing away the thick alders for a picture, it sank to the ground, with every appearance of complete exhaustion, and only by a severe prodding would it arise.

On the first snap of the camera, the animal collapsed, refusing to stir again. I certainly never expected to be sorry over the plight of such a marauder; but its bloodshot eyes, protruding tongue, the entire lack of resistance, and the dreadful sight of the broken skin clustered white with the eggs of the blue bottlefly would have appealed to the sympathy of its most relentless enemy; so a shot hastened the end.

From its condition it was plain that the animal was in the throes of death, due not to any injury, but to an overpowering mental strain, producing a complete physical collapse, and that, too, of an animal weighing eighty pounds and in the best of physical condition.

RESOURCEFULNESS OF THE TIMBER-WOLF

An illustration of the elusiveness and endurance of the timber-wolf occurred when one was found on Grand Island, in the fall of 1896. The first snow showed its presence, besides disclosing a large number of deer carcasses, including several of the imported black-tails.

Thereupon a large number of traps and poisoned bait were set out, but without result.

Then, to insure its destruction, a dozen of the best shots in the vicinity were em-



Photograph by George Shiras, 3d

A LARGE MINK TAKES ITS OWN PICTURE AT NIGHT

This is a representation of the animal that took, on a number of successive days, a victim from among the white ducks in the swimming pool, Whitefish Lake (see page 190).

ployed to hunt the animal. Taking up the trail in the snow, it was followed continually in the daytime for four days, when the animal was slightly wounded, which only increased its watchfulness.

At the end of nearly two weeks, with relays following it all day and sometimes at night with lanterns, the wolf was finally killed. With the wages paid and the loss of deer destroyed by this single animal the cost was estimated at \$1,500.

That an animal on an island, where it could be readily followed in the snow, was able to escape such a number of experienced hunters during this length of time shows how hopeless would be a similar pursuit on the main shore, where the avenues of escape are infinitely greater.

In the past fifteen years the coyote unexpectedly appeared in northern Wisconsin and Michigan, coming from Minnesota. It has since become very numerous, feeding on rabbits and killing many

young deer, besides threatening the sheep introduced in the cut-over lands.

Some twenty of these animals have already been trapped on Grand Island, a game preserve described in subsequent pages, and many are taken each year to the mainland. In weight they exceed those of the prairies, evidently responding to the heavily wooded area and the nature of their prey.

CHAPTER VII

USE OF THE CAMERA IN THE DAYTIME

In previous issues of this Magazine* I have described with considerable detail

* See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Wild Animals that Took Their Own Pictures by Day and by Night," July, 1913; "A Flashlight Story of an Albino Porcupine and of a Cunning but Unfortunate Coon," June, 1911; "One Season's Game-bag with the Camera," June, 1908, and "Photographing Wild Game with Flashlight and Camera," July, 1906.



Photograph by George Shiras, 3d

A BEAVER VISITING THE BOAT-HOUSE IN FRONT OF CAMP: WHITEFISH RIVER

This large beaver discovered a couple of young black ash and was tempted to visit the camp clearing. Where is its tail? At no time in six years have the river beavers been seen in daytime (see page 190).

the methods employed in nature photography, both by day and night, but have omitted largely the history of its gradual development, or how it has been used by the naturalists and sportsmen as an aid to science or the establishment of a new pastime; so some additional information is not out of place.

In looking over my diaries, beginning in 1878 and continuing to date, the following brief entry appears in 1886:

"WHITEFISH LAKE, *July 7-9.*—First day wounded bear on the way out; saw two deer in camp clearing. Second day photographed a deer. Guide, Jake Brown."

At the time indicated I owned a 5 x 7 landscape camera with a single lens, of slow speed, which had to be uncapped when an exposure was made; so a tripod was generally necessary. In some respects this instrument proved more satisfactory for scenic pictures than the modern outfit, for the use of the tripod in focusing and in the study of the field to be included, besides the small aperture of the diaphragm, resulted in well-defined

negatives and also precluded the carelessness so customary with a snapshot camera.

When the time finally came that the vacation was limited to the summer months, with an occasional brief hunt in the fall, the opportunity for outdoor sport was greatly reduced, but the "call of the wild" became intensified by the confinement and exactions of city life.

On these summer trips, in seeing the wild animals in the woods and about the waters, there was a lamentable lack of the interest aroused when the gun was in use. To paddle within range or cautiously approach some clearing and then see an animal slink away became monotonous to one accustomed to a keener and more exciting sport.

THE FIRST ATTEMPT TO PHOTOGRAPH A DEER

Likely it was this feeling which led to my suggesting to Jake Brown (the worthy successor to Jack La Pete) the possibility of photographing a deer. So one afternoon the flat-bottomed hunting



Photograph by George Shiras, 3d

A VARYING HARE IN A STRIKING ATTITUDE

Rarely is this animal seen in sunlight, for it feeds by night, but the white clover in the camp garden made it a frequent daylight visitor (see page 190).

skiff was prepared for the experiment, with a few green boughs in front screening the camera.

On entering the lake, an unusually large buck was seen standing upon a submerged rock opposite. Paddling through the reeds slowly, we came to open water fronting the animal, and as the bow cleared the reeds we were within forty feet of it, as it stood in a striking attitude. At this instant the boat, fortunately, ran on top of a sunken log, steadying it for the picture.

Quickly the cap was removed from the lens and then replaced. The deer, however, detecting this slight movement, ran a short distance, when it stopped, with head high in the air, gazing anxiously in our direction.

TWO PICTURES SPOILED AT ONCE

Meanwhile I had replaced the slide, reversed the plate-holder, and had time to make a second exposure, when with a

single leap the animal cleared the bushes fringing the water.

More excited than if I had killed this splendid specimen, the slide was picked up to cover the last exposed plate, when I was stunned at seeing the light-colored negative staring me in the face, for I had withdrawn the outer slide while watching the deer moving off, thereby destroying the first negative and not exposing the second.

Jake, of course, could not understand how it was possible to spoil two pictures by a single mistake; so, without any undue discussion about the manner in which I had blundered, the boat was headed for the slough, where a large doe was ready for the next effort. Somewhat suspicious of the partly screened boat, she allowed time for the removal of the cap, but before it could be replaced she ran back into the forest. On developing the plate, there could be seen the faint outline of the doe, and then a long white streak representing her retreat.

Following this short experience, it was apparent that only by the best of luck was it possible to get pictures of deer with such an outfit, and while just such luck had favored the initial effort, "buck fever" of the earlier days had brought almost complete failure.

THE FIRST PHOTOGRAPHIC APPARATUS OF ITS KIND

Several seasons previously, a friend of mine had procured a 4 x 5 outfit, called the "Schmidt Detective camera," having a high-grade, rectilinear, Dallmeyer lens, with a fairly rapid shutter, which could be set and released by a string and button on the outside of the box. This apparatus, which was the first of its kind, equaled the modern ones in effectiveness, and for my purpose proved very much better, for the plate-holders and lens were inclosed in a light, tight, waterproof box.

Using this camera, during the next season I was able to get several good pictures of deer. The lens, however, was of short focus, so it was necessary to get within about twenty-five feet of an animal for satisfactory results, and this was difficult in bright sunlight. So then I tried sitting in a blind near a runway or



Photograph by George Shiras, 3d

A GREAT BLUE HERON OPPOSITE THE AUTHOR'S CAMP

Frogs in the reedy shore across the stream attracted the blue herons, but the camp was watched closely by these cautious birds, Whitefish Lake (see page 190).

where the deer came to feed, but the shifting currents of the air usually indicated my presence before the quarry approached close enough, showing the difference between shooting an animal some distance away and trying to photograph it within a few yards.

ANIMALS MAKE THEIR OWN PORTRAITS

During subsequent seasons this difficulty was overcome by running a thread across a runway or the beaches, with the camera concealed a short distance away, and in this manner pictures were obtained without effort and of very excellent quality. Later, when leaving the camera out all day, it could be reset for night with a flashlight, and thus it was at work twenty-four hours—an important advantage when in the remote wilderness for a brief time.

Another method was to place two or three cameras in different parts of the slough, and when an animal passed in front of one the shutter was released by pulling a string suspended through screw-eyes on saplings and running thence to a

scaffold in a tree overhanging the water, where I could release the shutter of a camera by pulling the right string, the deer always stopped when I gave a shrill whistle (see page 134).

It seems odd now that in the beginning I had selected as an object for the first camera hunts the most cunning and elusive of the deer family instead of trying an easier subject, like a porcupine, a squirrel, or some of the many semi-tame birds nesting in the clearing about my camp. Of course, the explanation lay in the fact that I simply wanted to hunt deer, and the camera gave the means of gratifying this desire.

A QUOTATION FROM THE PAST

Soon the real and lasting merits of this instrument as a sportsman's adjunct became more and more apparent, and in such belief I wrote in advocacy of this new pastime an article published in 1891. It indicates a violent reaction against useless destruction, but it at least bears witness to a confidence in the camera as the sportsman's best friend.



Photograph by George Shiras, 3d

A DEER FAMILY FEASTING ON MOUNTAIN-ASH BERRIES BEFORE THE BOAT-HOUSE

These wild berries were so placed that deer passing toward the garden would fire the flashlight, showing the boat-house in the background (see page 191).

"A sportsman's life consists largely of three elements—anticipation, realization, and reminiscence. The look forward to the trip by rail, by canoe, and then perhaps a tramp on foot into the heart of the wilderness; then the camp and its pleasant surroundings, and that memorable day when the early morning sun casts a glint upon the branching antlers of a mighty moose as, half concealed in the thicket, he furtively browses his way along; the breathless wait until the neck or shoulder becomes exposed; the shot, and then—success—that is, sudden death, or perhaps delightfully intensified by a hasty scramble after the wounded beast on a blood-stained trail, at the end of which we find our victim dead or dying.

"Would that we could realize that what is game to the rifle is game to the camera! Nearly every sportsman will admit that the instant his noble quarry lies prone on the earth, with the glaze of death upon the once lustrous eye, the graceful limbs twisted in the rigors of death and the tiny hole emitting the crimson thread of life, there comes the half-defined feeling of repentance and sorrow.

"The great desideratum, after all, consisted of neither meat nor antlers nor

hide. Therefore the conclusion is reached that much of the large game, when successfully hunted, is the victim of an abnormal incentive.

"Surely we do not travel a thousand miles, indifferent to time, labor, and expense, to get a few hundred pounds of wild meat, probably not half so toothsome as the domestic cuts in the market stalls of our own town and costing very much more.

THE THRILL OF THE CAMERA HUNT

"Every camera hunter will admit, even though once a successful sportsman, that there is more immediate and lasting pleasure in photographing a deer at twenty yards than in driving a ball through its heart at one hundred yards. Then, think of the unlimited freedom of this noiseless weapon. No closed season, no restriction in numbers or methods of transportation, no posted land, no professional etiquette in the manner of taking your game.

"You can pull on a swimming deer or an elk floundering in the snow; take a crack at a spotted fawn; bag the bird in its nest or string your cameras out with a thread across the runway and gather in



Photograph by George Shiras, 3d

VISITING THE CARROT PATCH

This doe selected its favorite vegetable within ten feet of the cabin containing the dining-room, wherein many a haunch of venison has been served during the hunting season. At no time are these night visitors seen in or about the garden in daylight. Cautious as they are, many of them lose their lives in the hunting season, a few months later, in which hunts the writer no longer participates (see page 191).

the exposed game-laden plates at night-fall without any scruples of being called a pot-hunter.

"By and by you will have a collection of pictures affording more enjoyment than all the mental ghosts of slaughtered quadrupeds and all the moth-eaten relics of the gun; for, when one covers an elk or a moose with his single barrel, close shooting, long-focus lens, there is no pulling off the hide while the coyote and the birds of prey feast on a thousand pounds of meat too rank in the rutting season for food or too cumbersome, if edible, to be generally available.

"In each essential particular the camera requires all the proficiency and affords all the pleasure that a steady hand and a deadly weapon ever gave a lover of field sports, and more besides.

"It is only within the last few years that compact photographic appliances, quick shutters, rapid dry plates and films have made possible successful work on

large game, or otherwise some of us might have reformed before."

Whatever may have been the writer's particular contribution toward wild-life photography in the daytime, it was of a non-essential character, so far as the immediate future was concerned, for the method would soon have developed naturally on the coming of proper apparatus.

A year or two later Wallahan, of Colorado, on his own initiative and with an ordinary tripod camera, succeeded in getting a remarkably beautiful series of the mule deer during their descent from the mountains each fall, and later, with better equipment, photographed many other animals in his State.

Then Chapman, our leading ornithologist, began picturing birds, his collection not being surpassed by any individual at the present time; followed by Kearton, of England, who soon became the foremost bird photographer across the seas.

The next effort of the writer was to

try photographing animals at night by flashlight, about the waters in the vicinity of his camp. In this experiment many difficulties arose, which may best be considered as a separate subject.

WILD LIFE PHOTOGRAPHY BY NIGHT

In the earlier days, about Lake Superior, the old Indian method of "fire-hunting" deer proved most fascinating. True, this practice has long been outlawed as unsportsmanlike, since it required little skill and became very disastrous when followed systematically by market hunters.

Even at that time, the real pleasure in hunting at night, to most of us, was not so much the actual shooting as the keen enjoyment derived in paddling quietly along the winding streams or the well-wooded shores and bays of some inland lake, where in the quietness of the night every sound was audible, and one readily learned to know the different animals before they came within the circle of the light.

Unless the primary object was obtaining meat for camp, it was disappointing if a deer were killed within the first half hour, thus ending the trip.

Another method of night hunting was the use of a headlight on shore, the hunter quietly wandering about in the blackness of the forest looking for a pair of gleaming eyes, fifty or more yards away, and then with a rifle trying to put a ball between the few inches separating these brilliant orbs, requiring an accuracy of aim, a knowledge of the woods, and a skill in still hunting quite up to the standard in daylight shooting.

But here again the market hunters became so proficient under conditions already described that this method also had to be prohibited.

THE IDEA OF NIGHT PHOTOGRAPHY CONCEIVED

Having taken daylight pictures of deer in various ways, the question then arose whether there was any possible means of doing this at night, when the deer were much more active and could be approached more easily than at other times, thus reviving, in a harmless but interesting way, jack-light hunting, so little known by those of the present day.

Assured by an extended experience in both methods of hunting under the light, there seemed little doubt about getting close enough for pictures, provided the magnesium powder was a sufficiently powerful illuminant and had the requisite speed.

"SHOOT THE DEER FIRST"

This new endeavor was mentioned to Jake Brown in the summer of 1889, but he was still a trifle irritated over an experience of the previous fall, when, after the season had opened, I photographed a fine buck and shot at it afterward, resulting in badly wounding the animal as it ran away, entailing a half day's search before it was overtaken and put out of misery, for the lower jaw had been crushed by the rifle ball, giving a pitiful illustration of how some animals must suffer in the name of sport.

This led Jake to exclaim that if the camera must be used, the best thing to do was to shoot the deer first and photograph it afterward! However, as the season would not open for several months, he got the boat ready for the night, while I attempted to devise some sort of a flashlight apparatus.

A small hole was made in the center of a tin plate, in which was placed a strip of oiled paper that would burn readily when ignited underneath, and on top was placed the magnesium powder.

The approach was to be made in the usual way, with a jack-light.

FIRST ATTEMPT PARTLY SUCCESSFUL

This first effort was entirely successful, so far as getting within range; but just as the lower end of the paper fuse began burning, the deer ran off with a snort of disapproval, the flash taking place after it was out of sight. Jake, as might have been expected, indulged in his usual guffaw, while I hopefully began preparing another charge.

At the left-hand corner of the sand beach stood a large doe, much interested in the approaching light, and soon the boat came within 25 feet, the flashlight being fired when the animal was apparently motionless.

On developing the negative the body of the deer was satisfactory, but the head had moved so violently the animal seemed decapitated.



Photograph by George Shiras, 3d

FINISHING UP THE BRUSSELS SPROUTS

This deer took its picture at midnight before the cottage of the caretaker, whose sleep was doubtless momentarily disturbed by the explosion. But, as such raids were a continual strain on the temper of the gardener, he always welcomed the sound of the flashlight (see page 191).

This unexpected result was discouraging, so several trials were made the following night; but again the pictures were nearly worthless, for the same reason as the first, showing that the powder was too slow for an active creature like a deer when facing a slowly exploding illuminant.

Later experiences proved, however, that even with this crude apparatus a good picture might have been taken occasionally had the flashlight been discharged when the deer had its head down or was turned away from the water.

During the ensuing winter I learned of a flashlight apparatus designed for taking pictures in theaters, ball-rooms, or other large interiors, consisting of a metal standard supporting three circular alcohol lamps, into the flames of which could be projected a spray of magnesium powder by means of a rubber bulb connected by tubing with a receptacle containing enough powder for half a dozen flashes.

This apparatus, with its great power of illumination and ease of manipulation, seemed suitable for solving the problem.

UNEXPECTED PYROTECHNICS

On the first dark of the moon the following July I left camp in a canoe with the new outfit in the bow and the ever-faithful Jake astern, going downstream from camp to avoid the winds of the open lake.

A reflector had been placed behind the three lamps with the idea of covering the jack and utilizing the other light when finally approaching a deer.

In one place it was necessary to lift the canoe over half-submerged rocks; but, as we both wore gum boots, this was easily done. Shortly afterward it was realized that this little portage had probably saved the flashlight hunter from severe injuries.

On rounding the next bend a pair of



Photograph by George Shiras, 3d

A DOZEN FROGS CATCH NEARLY ONE THOUSAND BUTTERFLIES

Early in August, 1919, the half dozen little Leopard frogs living in the camp water garden near Whitefish Lake were seen catching, every few minutes, butterflies known as "the little white-banded blues," as each alighted on a row of forget-me-nots bordering the water. Frequent observation during a week indicated the killing of fully 500 butterflies. On the bank of the stream was a bed of sweet-william, where another set of the little green frogs lay in wait, these catching a brown species (shown above) almost as frequently. It is worthy of note that two distinct species of butterflies fed exclusively on two different species of domestic flowers. The brown butterflies, however, fed by the hundreds on joe-pye weed along the stream, but beyond reach of the frogs. The photograph was made from above, causing the butterfly (*Argynnis aphrodite*) to appear disproportionately large.

glowing eyes attracted attention, and in a moment the three lamps were ablaze and the jack-light covered. On approaching, the deer jumped to one side, requiring the canoe to change its course, for I had not then in use a revolving table capable of covering any quick movement of an animal.

In turning to whisper instructions to Jake, my elbow unfortunately caught on the rubber tubing, toppling the entire apparatus into the bow, where the cap of the reservoir became detached, permitting the escape of all the powder, part of which clung to the wet surface of the rubber boots, the remainder going into the bow, where a portion was set on fire by the overturned lamps.

There was a tremendous explosion of the drier powder, and the damper portion

gave forth a brilliant spluttering, compelling me, in a cloud of stifling smoke, to leap overboard in order to extinguish the blaze on the boots and later in the boat.

Having been turned toward the paddler when the mishap occurred and because much of the powder was wet, my eyes were protected, affording an early warning in the handling of such an explosive.

JAKE GETS A DUCKING

When Jake learned that no particular harm had been done beyond the puncturing of a chimerical scheme, he gave vent to unrestrained mirth. Standing waist deep in the slowly moving current, my hands smarting from the touch of the flames, and the little camera floating about in the murky waters, any humor

in the affair was not particularly noticeable to at least one member of the party.

Opening the cover of the jack-light and turning the rays toward the stern, the sight of Jake in a state of hilarity, with a superabundance expressed by whacking the paddle on the water in rhythm with each outburst, I gave an upward pull on the already-elevated bow of the canoe, and down went the stern to the bottom, only Jake's eyes showing above the surface, stifling every sound except a little spluttering.

As Jake struggled to his feet, a grinning countenance showed his willingness to take good-naturedly this somewhat rude form of reprisal. In a few minutes the boat was ashore, the water removed, and the camera found on a near-by sand-bar. While returning, my now sympathetic assistant attempted a diversion by pointing out in graphic language how surprised the deer must have been "when the moon blew up," but the monologue was not interrupted.

A SUCCESSFUL FLASHLIGHT APPARATUS IS DEvised

In the succeeding months experiments were made with a new powder, called Blitz-pulver, a compound possessing great brilliancy and rapidity, and only requiring an apparatus that could be quickly and safely handled to insure satisfactory results.

Sportsmanlike, the idea of a pistol flashlight then suggested itself.

During the winter I had made a tin box an inch deep and seven by four inches wide, containing an iron bed-plate on which a spring-actuated firing-pin could be released by a trigger beneath the box, using for ignition a capped, but empty, pistol cartridge, which extended through an upright shoulder far enough to penetrate an opening in a pill-box containing half an ounce of powder.

This contrivance, when tested, showed it could be fired with the quickness and certainty of a gun, the strong metal bed-plate protecting the hand when the machine was held overhead.

On next returning to camp in the summer of 1891, I found that Jake would be occupied several months building a hunting cabin for a relative of mine on a little lake several miles to the west; so

the next experiment had to be tried with a different paddler in the stern.

Fortunately, a good substitute was at hand, for some years previously I had employed, occasionally about the camp, but more frequently in fishing along the shore, a Norwegian named John Hammer. Although a machinist by occupation, since coming to this country, in the early eighties, his racial fondness for the water led his employers to take him on camping trips, where his expertness as an oarsman, a paddler, or in running a naphtha launch finally led him to act as a guide during the summer and fall months.

Sending for John, I explained that he was to take on a novel occupation, that of "a flashlight guide," and for an indefinite period, little anticipating his continuance in that capacity to the present date, a period of more than thirty years and covering expeditions throughout much of the northern continent.

John accepted this invitation with surprising cheerfulness, for in those days the idea of using a camera instead of a gun did not take very well with most guides, who naturally thought that in hunting big game there should be something more substantial to show than the image of what, in the flesh, represented a fine stew or roast.

Perhaps part of the explanation lay in the fact that at his own former home in Christiania he had served as an apprentice in an optical works and had always felt a considerable interest in photography, thereby viewing his new duties with a seriousness and appreciation speaking well for my future efforts.

One night about the middle of July, in the following year, the new apparatus was put into the canoe and a start made up the river under the confident belief of a greater measure of success than had heretofore fallen to my lot.

THE FIRST SUCCESSFUL FLASHLIGHT OF A DEER

On the way to the lake several deer bounded off, but too far away for a picture. Passing along without looking for any animals in the reeds, as the open shore of the slough afforded a less obstructed view, we entered it with no idea of seeing a deer for several hundred yards, and were, therefore, surprised on

discovering a pair of shining eyes of what proved a yearling buck, only a few feet beyond old Jack's landing, where, as a boy, I had brought in triumph a little buck as the first victim of the gun.

What a coincidence if, on the same spot, I could now obtain an image much more lasting than the vanished one of years ago!

The deer viewed the approaching light with unusual curiosity, raising and lowering the head as if to look under or over the jack-light. Just as the neck was craned and the head elevated, the flash was fired, the camera hunters and the deer being equally blinded, for at that time we had not learned the advantage of closing one eye when the explosion took place.

Before our vision had returned the deer was heard struggling through a mass of alders, and then, without making another trial, we hastened to camp, where the developed plate showed the little buck in the center of the scene, with a foreground of reeds and a background of alders and cedar, depicting the first successful effort in the recording of an animal on its midnight rambles (see page 135).

THE LURE OF NIGHT HUNTING WITH A CAMERA

Having, therefore, learned in the succeeding year that night hunting with the camera possessed a greater attraction for the average sportsman than when the object was the death of the animal, I endeavored to show this through the columns of an outdoor magazine, and as a part of the present record its reproduction may be in order, especially as these early views have been more than sustained in the twenty-five succeeding years:

"Selecting a dark, warm night, a flashlight hunter prepares his cameras, lights the jack-lamp, loads his flashlight apparatus with magnesium powder, and in his canoe pushes out into the silent waters of the lake or river. The paddle sends the slight boat ahead so easily that no sound is heard except a gentle ripple, unnoticeable a boat's length away. The wooded banks are wrapped in deepest shadow, only the sky-line along the crest showing their course.

"At the bow of the boat the bright eye of the jack-light is turning from side to side, cutting a channel of light through the waves of darkness, showing, as it sweeps the banks, the trunks of trees and tracery of foliage with wonderful distinctness.

"Soon the quick ears of the men in the boat detect the sound of a deer feeding among the lily beds that fringe the shore. Knee-deep in the water, he is moving contentedly about, munching his supper of thick green leaves.

"TWO BRIGHT BALLS SHINE BACK"

"The lantern turns about on its pivot and the powerful rays of light sweep along the banks whence the noise came. A moment more and two bright balls shine back from under the fringe of trees; a hundred yards away the deer has raised his head and is wondering what strange, luminous thing is lying out on the surface of the water.

"Straight toward the mark of the shining eyes the canoe is sent with firm, silent strokes. The distance is only seventy-five yards, now it is only fifty, and the motion of the canoe is checked till it is gliding forward almost imperceptibly. At this point, if the hunting were with the firearm, there would be a red spurt of fire from under the jack-light, and the deer would be struggling and plunging toward the brush; but there is no sound or sign of life, only the slowly gaining light.

"Twenty-five yards now, and the question is, Will he stand a moment longer? The flashlight apparatus has been raised well above any obstructions in the front of the boat, the powder lies in the pan ready to ignite at the pull of a trigger; everything is in readiness for immediate action. Closer comes the boat, and still the blue, translucent eyeballs watch it. What a strange phenomenon this pretty light is! Nothing like it has ever been seen on the lake during the days of his deerhood.

"A CLICK, A WAVE OF LIGHT, THEN DARKNESS"

"Fifteen yards now, and the tension is becoming great. Suddenly there is a click, and a white wave of light breaks out from the bow of the boat—deer, hills,



Photograph by George Shiras, 3d

BEAVER REPAIRING DAM AT NIGHT

For the purpose of showing a dam and the beaver at work on it, a break was made one afternoon, and when the animal came after dark to investigate the cause of the falling water, a set camera and flashlight pictured it within the break. Taken in October, 1912, 45 miles west of Marquette (see page 197).

trees, everything stands out for a moment in the white glare of noonday. A dull report, and then a veil of inky darkness descends.

"Just a twenty-fifth of a second has elapsed, but it has been long enough to trace the picture of the deer on the plates of the cameras, and long enough to blind for the moment the eyes of both deer and men. Some place out in the darkness the deer makes a mighty leap. He has sprung toward the boat and a wave of water splashes over its occupants. Again he springs, this time toward the bank. He is beginning to see a little now, and soon he is heard running, as only a frightened deer can, away from the light that looked so beautiful, but was in fact so terrifying.

"What an account he will have for his brothers and sisters of the forest of a thing which he himself would not have

believed if he had not seen it with his own eyes. In the boat, as it slips away from the bank, plates are being changed and the cameras prepared again for another mimic battle."

MAJORITY OF WILD ANIMALS ARE NOCTURNAL

In the course of time it became plain to the writer that the easiest and most satisfactory method of picturing wild game was through the use of the flashlight, for by far the greater number of wild animals are nocturnal, and when occasionally seen in the daytime can rarely be approached sufficiently near with a camera or when the light is favorable.

However, it was many years before any one else could be induced to make the effort, for it seemed hard to find one who was both a naturalist and a photographer,



Photograph by George Shiras, 3d

BEAVER CUTTING DOWN A BLACK ASH AT NIGHT: THE FIRST PICTURE OF ITS KIND

For two weeks the camera and flashlight faced this partly cut tree without result. Then one night the beaver came, leaving his picture as well as the tree, for it stands today unfelled, proof that a single animal does the work (see page 197). He was too frightened by the flash to return that season.

or, being such, had any knowledge in the use of flashlight powder and the means of approaching animals at night.

Finally, many years later, Nesbit and Dugmore, of this country, became interested, followed by Schilling, of Germany, the latter two of whom obtained remarkable night pictures on their African expeditions. Then came a host of others, whose fine and ever-increasing collections indicate the success and permanency of this method of night photography, both as a sportsman's pastime and for the scientist, when desirous of presenting wild life in its natural habitat.

PHENOMENA OF FLASHLIGHT COMPOUNDS

The range of illumination, out-of-doors, of the modern flashlight powders is limited in animal photography to about fifty feet, unless a very heavy charge is used, in conjunction with a long-focus lens.

However, the direct and collateral rays of this powder have an extraordinary range.

Homesteaders living four or five miles beyond the author's camp for some years have noticed the sudden glare of light on the sky overhead, and by inquiry finally traced the origin to the flashlight pictures being taken at or near the camp.

This led to a careful and more extended test. By prearrangement, an ounce or so of flashlight powder was fired one night in the camp, surrounded by high trees, while well below the horizon at Marquette, 20 miles distant, spectators were to report the result. They noticed a bright illumination, not only above the camp site, but its extension apparently for five or six miles along the horizon, resembling heat lightning, except for its steadiness and straight lines. Subsequent trials did not vary.

Flashlight rays will penetrate clear water for a considerable distance at night, making possible subsurface pictures, so difficult of accomplishment in the daytime, and will also permit the photographing of the interior of a room through closed windows, when the camera and flashlight are at a considerable distance on the outside—an impossibility in daylight (see picture, page 191).

Moreover, when these rays come in contact, at right angles, with those of a

strong searchlight, a mile away, there appears a peculiar and very noticeable fluttering at the junction, not unlike heat lightning. This too, was tried a number of times. Apparently flashlight powder possesses properties unlike any other artificial light, and warrants an investigation by a physicist, or at least an explanation from one. So far no solution has been offered of the last phenomenon.

CHAPTER VIII

GRAND ISLAND AND ITS HERD OF ALBINO DEER

Doubtless many former readers of "Robinson Crusoe," who later have had occasion to explore remote places on land or sea, retain a special interest in islands, more particularly when such places are in a primeval condition, with a variety of plant and animal life.

Physical barriers serve not only in preserving the purity of a given species, but are often the means of furthering the origin and continuance of new forms; for all organic life has its abnormalities, and some may develop a freakish manifestation into a permanent character, just as others yield gradually to environmental influences, especially where not indigenous to the region.

Lying athwart the entrance of one of the few deep bays on the southern shore of Lake Superior is Grand Island, true to its name in size and beauty. Terminating the westerly end of the famous Pictured Rocks, its giant sandstone cliffs on the north end face the widest portion of the lake, while the nearly land-locked waters on the inner side afford the only natural harbor for many miles (see map, page 114).

CAMPING PLACE OF OJIBWAY INDIANS FOR CENTURIES

This was the camping place of the Ojibway Indians for many centuries, and later a trading post was established, with the interesting life incident thereto.

When tourist travel began, in 1855, on the completion of the first lock at Sault Ste. Marie, this precipitous part of the coast, with its multicolored cliffs and castellated rocks, was seen at close range from the deck of passenger steamers.

Grand Island, with a shoreline of about



Photograph by George Shiras, 3d

NIGHT PICTURE OF A BEAVER PLASTERING HIS HOME WITH MUD

In the fall these animals renewed the covering of mud on their house, not only for comfort, but as a protection against marauding animals, which cannot tear the structure apart when cemented with frozen mud. The picture shows the home of the beaver colony living on the river half-way between the author's camp and Whitefish Lake (see page 197).

40 miles, heavily forested, containing lakes, ponds, and overflowing streams, was always the resort of wild game, the deer in particular being attracted by several natural salt licks near the center of the island.

When a youth, I camped each season with older members of my family on the opposite shores, where so abundant were the trout, deer, wild pigeons, and grouse that only on rare occasions was the island visited.

THE ISLAND CONVERTED INTO A GAME PRESERVE

Whenever I ventured into the dark, tangled forests, it seemed that the deer had inherited a greater degree of sagacity than those roaming in comparative safety throughout the unbroken wilderness ashore, due, doubtless, to the peril of island segregation and the inherited fear of the Indian and the fur trader, who

made this locality a general rendezvous and hunting ground.

Provisionally, in modern times this beautiful island has been saved from the ravages of the axe and the too deadly use of the gun, for a number of years ago it was acquired by a mining and lumber company in the purchase of a larger tract ashore.

Unlike many of the pioneer corporations of the West, this company has always shown a commendable interest in the welfare of the various communities in which it has operated, leaving more than a fair equivalent for that which must be destroyed. It was this spirit which led to an extensive effort to protect the native wild game and to introduce new or foreign species most likely to succeed in a northern country.

Starting with a hundred or more native deer, moose were introduced, together with elk, caribou, black-tail deer,



Photograph by George Shiras, 3d

THE LODGE OF THE RIVER COLONY OF BEAVERS

Showing a great collection of brush and small logs stored in the pool before the house for their winter supply of food (see page 181).

antelope, and several hundred pairs of Scandinavian game birds. For the use of the last-named, thousands of young Scotch firs were successfully planted, to provide their natural winter food. The results of this experiment are interesting and of value for the future.

The Scandinavian birds, principally capercailzie, raised a brood or two, and then fell victims to birds of prey and ground vermin, showing their inadaptability in a country otherwise suitable. Their foes were too numerous and were different from those across the sea.

A HERD OF CARIBOU PLUNGES TO DEATH

The first herd of Newfoundland caribou on a stormy winter night went headlong to their death when pursued by a stray timber-wolf. They leaped from one of the higher wooded cliffs into Lake Superior, under the sheep-like influence that causes these animals to follow a leader and to regard the distance traveled rather than cunning evasion the best means of eluding a pursuing foe. The entire herd perished (see page 144).

The next importation of caribou developed both species of bot-fly that have always proved such a dreadful and unsightly affliction on their native island; but, unable to suffer and recover, as in

their original habitat, these animals also came to a pitiful end.

Again, a wolf crossed on the ice and, getting beneath the game fence confining the animals to the higher ground, soon put an end to the black-tail deer, for they lacked the elusiveness of the white-tail; while the antelope, as rather expected, found the few clearings too small for their roaming habits, and in the deep snows characterizing the upper lake region they gave up the struggle for existence.

THE MOROSE MOOSE VANISHED, TOO

The moose at first thrived and bid fair to succeed in a country adapted to their ways, but on the tremendous increase in the white-tail deer and elk, they refused to travel the runways of their uncongenial rivals. They secreted themselves in a swamp bordering a small lake, where lack of range and food brought on disease, and then these morose and stolid animals vanished, the usual result with moose when too confined—a fact which accounts for the rarity with which they are found in zoölogical parks.

The native white-tail, therefore, won the day against all enforced intruders except the elk. Consequently in these two species we have the ones best adapted for



Photograph by George Shiras, 3d

A TYPICAL SCENE ON WHITEFISH RIVER

From 25 to 30 ash are in different stages of felling or dismemberment, showing that these beavers do not finish one tree before beginning on another. Average time in felling a tree, ten days (see page 197).

the unoccupied ranges throughout the more easterly part of the country.

A closed hunting season on any island, however big, will finally bring most animals face to face with an unavoidable enemy—starvation. Thus it became necessary to supply some food in winter, besides shipping hundreds of deer and surplus elk to parks and game preserves, followed still later by an open season on deer.

THE BEGINNING OF THE ALBINO DEER COLONY

If, however, this long and costly effort to make Grand Island the permanent

home of many immigrant species has proved disappointing, an unexpected reward has come, which may eventually prove of greater value than the fulfillment of the original plan, namely, the establishment of a beautiful herd of albino white-tail deer.

A characteristic of the Michigan deer has been the general uniformity in physical appearance; for, though more deer have been killed in Michigan during the past fifty years than the aggregate elsewhere, there are very few freaks in antlers or extremes in weight, while albinism has been equally rare.

Some ten years ago word came that a fine albino buck had been seen frequently on Grand Island coming to a little pond on the easterly side. Taking a camping outfit, a canoe, and my guide, several days and nights were spent watching the pond, and although other deer came during the day or were seen under the jack-light, the white buck did not appear.

The next year the quest was no more successful, and when I heard that on the opening of the season the white buck had been killed, it was a consolation to know that the body was in the hands of a taxidermist, preparatory to being added to the little museum of the island hotel.

There, later, I took the measurements of the antlers and body, and then, to show what a striking picture such a marbled figure would present with a background of black, the mounted animal was carried one evening to the edge of the forest where once it had roamed and the flashlight fired (see page 148).

Feeling quite confident, from the age of this buck, that white descendants would sometimes be found, a careful watch was maintained throughout the island.

Finally, in the fall of 1915, a good-sized albino buck was noticed loitering about the box traps set for capturing deer to be shipped away. With little effort it was taken.

Upon the removal to temporary quar-



Photograph by George Shiras, 3d

FELLING A TREE UNDER DIFFICULTIES

A beaver cuts through the average tree in a space between 18 and 25 inches above the ground. After cutting on the opposite side this beaver had to finish the job while seated on a log. Note its resemblance to a large muskrat (see page 194).

ters it was found that the buck was suffering from an injury to the spine and was unable to stand.

Recognizing the rarity of such a capture, a regular attendant was placed in charge, and daily it was fed and watered in a reclining position. After a month it recovered sufficiently to walk about, and by spring was in good condition.

DEER WOULD NOT ALLOW KEEPER TO
CHANGE HIS COAT

Then an odd thing happened. The faithful caretaker, on approaching the stall one morning, was surprised at the buck showing the greatest terror, plunging about in a way to threaten new injuries. Retiring at once, the question arose as to the cause. Remembering that for the first time he had not worn his winter fur coat, it was replaced, and the buck became docile at once, showing how animals, usually dependent upon scent, may associate an outward garment with identity. Possibly this old fur coat had an odor of its own!

Then the idea of establishing a herd of white deer suggested itself, and with this in view four red does were captured and placed in a good-sized range with the white buck.

A WHITE FAWN FOUND

A few weeks later the project was favored by finding a female white fawn, a day or two old, in a thicket near the island hotel. With careful attention and in the company of another fawn, it grew rapidly.

During the earlier months this fawn had the usual row of white spots on the back and sides, and although there was no difference between these and the body color, they were conspicuous in the same way that satin needlework in a single color may carry a varied pattern (see page 147).

The following year one of the red does in the inclosure bore an albino doe fawn, which lacked, however, the brocaded white spots characterizing the previous one.



Photograph by George Shiras, 3d

CUTTING DOWN A GREAT BLACK ASH: WHITEFISH RIVER

The principal winter food of the beaver on the lake and river is obtained from the hundreds of black ash growing only a few inches above the water level and reached by side channels or sometimes artificial canals. After the smaller ones were cut came others of considerable size. The tree in the picture is 91 inches in circumference, and for three years different beavers have attempted to cut it down, but the flashlight has discouraged the completion of these efforts. The animals store the branches of the tree and eat the bark.

By this time the first fawn had become a yearling and was placed in the same inclosure. Three years ago I learned that there was a yearling albino doe at the State Game Farm, and in a few weeks it was safely transported to Grand Island, where such an addition in new blood has proved of undoubted value.

Then came a telegram in 1919 that the white buck had died suddenly in Novem-

ber, leaving only a buck fawn as the future head of the herd.

In the following spring, however, a posthumous white fawn was born, followed by the favorable news that a large albino doe and two white fawns had been seen on several occasions in a remote part of the island, and these latter can be placed in the inclosure if deemed advisable.

It may be of interest to note that the original buck weighed about 150 pounds and possessed a rather extraordinary set of antlers, spreading 26 inches, with the terminal points much farther apart than any other I have ever seen.

VELVET ON ANTLERS WAS SNOW-WHITE

The velvet on the antlers of both bucks was snow-white, giving them a most statuesque appearance amid the green foliage of the forest.

The eyes of the native albinos are a very light gray-blue, while the doe from the southern portion of the State has the usual red eyeballs. The lack of any pigment in the layers of the retina of this latter individual discloses the red blood-vessels characterizing most albinos, making it very susceptible to a bright light.

The second buck differed from the original one in being somewhat larger, but had only two long spikes of about eighteen inches, the left one slightly forked each season.

The albino deer shed their white summer coat at the usual time, and it is replaced by a heavier and thicker covering, though not quite so long as the winter gray coat of the normal deer. The skin is a light pink, showing plainly through the thin summer coat, in contrast with the almost black epidermis of the other deer. The hoofs and skin of the nostrils are a pearl-gray, instead of black, while the velvet on the growing antlers is white, but when freed from this covering the antlers have the usual brownish-yellow coloring, the only exterior part of the white deer resembling the normal ones.

THE FIRST ATTEMPT TO PERPETUATE ALBINO DEER

Up to the present time, the effort to perpetuate an albinistic strain has been largely confined to white mice and rats, white rabbits, and poultry, for in the larger animals this occasional recession from normal only results in the killing of such conspicuous objects, man and predatory animals being alike responsible. Moreover, when occasionally captured, it rarely happens a mate can be found of similar color.

This white phase is found in all organic life, as, for instance, elk, deer, porcupine (see page 121), beaver, muskrats, squir-

rels, many wild-fowl, robins, swallows, crows, blackbirds, woodcock, and in frogs, fish, insects, and several forms of plant life, due to the absence of pigment. This deficiency in coloring affects only the outer skin, the hair, or feathers, as well as the retina of the eyes and the hoofs of most quadrupeds. Partial albinism is frequent, and in New Brunswick I saw a number of deer splotched with white of various patterns, giving some of them a strikingly odd appearance.

The writer has been under the impression that the first offspring of albinos were usually white, and on and after the third generation uniformly so, following the rule in silver and black foxes. Several biologists, however, have contended that "albinism being a purely recessive character among mammals, albinos should breed true from the first." That this conclusion is sometimes a mistake was shown a year ago, when one of the white does bore a normally colored fawn, the white buck being the only male in the inclosure.

There are many nature lovers, vitally interested in the efforts of science to produce and perpetuate new variants of existing species, who will be gratified to know that as time goes on specimens of this new and beautiful phase of the white-tail may find representation in other parts of the country. The various members of this original albino colony are shown herein at different ages, in varied attitudes, and in contrasting seasons.

CHAPTER IX

MOOSE ON ST. IGNACE ISLAND

Diagonally opposite Marquette and on the north shore is an interesting and beautiful group of islands, the largest of which, St. Ignace, occupies the entrance to Nipigon Bay, into which flows the most famous of Canadian trout streams.

On a trip west of Port Arthur, in 1916, for the purpose of studying the moose along the international waters between Minnesota and Ontario, I was told that several of the larger islands near the Nipigon contained an incredible number of moose, but as at this point the line of the Canadian Pacific follows the shore, in sight of the islands, the report seemed somewhat doubtful. However, in the



Photograph by George Shiras, 3d

FLASHLIGHT OF A BEAVER TOWING A SAPLING, WHICH IS TO BE ADDED TO ITS STORE
OF FOOD FOR WINTER

Unlike the muskrat, with its body well out of the water (see page 199), the beaver swims nearly submerged, with only the head showing (at the right). At a distance it is sometimes hard to tell one from the other when swimming, except by the greater speed and wake of the beaver.

following year it was decided to investigate, for except on Isle Royal, the largest island in the lake, the moose had not been authoritatively reported as island occupants.

It should be stated that for some years after the writer came to Lake Superior moose and white-tail deer were unknown on the north shore, although caribou were abundant, especially in the fall and winter.

MOOSE MIGRATED FROM QUEBEC

About 1885 a steady movement of the moose westerly from Quebec was observed and a slower easterly migration from northern Minnesota. Eventually these animals commingled and took possession of the entire shore, later extending into the interior until they reached the waters flowing into Hudson Bay.

Following the moose came the white-tail deer and many timber-wolves, when the caribou began yielding the possession of centuries.

After the construction of the railroad, extensive lumbering and many forest fires changed the face of the country, large clearings and a mixed vegetation succeeding dense evergreen forests, and to this change may be principally attributed the influx of new animals and birds.

Most of this land being unsuitable for settlement insures a permanent and widely extended range for many of the big-game animals suffering eviction in districts valuable for mining or agriculture.

In September, 1917, our party arrived at RosSPORT, a little fishing village between the railroad and a bay opposite Simpsons Island, next in size to St. Ignace. Here provisions and canoes were obtained, and a few hours later the little tug was on its way, the party alert to detect the first island moose, the pilot having given assurance that before reaching the camp site several would be seen.

MOOSE FOUND FEEDING IN THE LAKE

When passing through the broad channel separating the two larger islands, three moose were noted well out in the shallow water at the end of a long bay, the first time in my experience that any such game animal was found feeding in the waters of Lake Superior, which, by reason of its depth and temperature, contains little aquatic vegetation.

Along the winding shores was noted a great variety of second-growth trees particularly suitable as browsing material for the moose, such as poplar, cherry,



Photograph by George Shiras, 3d

PARENT AND YOUNG BEAVER EATING THE BARK OF A POPLAR LOG USED BY THE
AUTHOR AS BAIT

Only once did more than one beaver appear on the negative. Here a small poplar log attracted the mother beaver and her youthful offspring.

birch, soft maple, mountain ash, and balsam, while interspersed the dense forests of spruce offered a safe retreat from the hunter and an excellent shelter in the winter, being the only tree never eaten by moose or deer in this region.

WATCHING FOR MOOSE AT THE SALT LICKS

However, the apparent abundance of arboreal food was misleading, for it was now seen from the boat that all the lower limbs of the trees referred to had been eaten or destroyed by the animals for some ten feet above the ground, accounting for the moose just seen in a shallow bay, where the temperature permitted an unusual growth of water plants (see page 163).

Unlike Grand Island, with its precipitous cliffs to the north, most of the exposed shore of St. Ignace Island was low, with many bays separated by narrow, rocky points offering suitable camping places, where reefs and shallow waters seemed favorable for the best of trout fishing, while inland were high, rounded hills approaching an altitude of fifteen hundred feet, besides several rocky ridges dividing the island into many basins filled with the purest water, ranging from

ponds of an acre to a lake four miles long, totaling nearly fifty on an island eight miles by five in size.

The tents were pitched on a level bank in a well-sheltered grove, at the edge of which flowed a fine trout stream leading from the largest of the interior lakes (see page 157).

Although facing the widest portion of Lake Superior, it was our intention to spend most of the time looking for moose in near-by ponds, as well as watching for them at several natural salt licks in a deep valley behind the camp.

BIG MOOSE HERD LIVING ON WATER PLANTS

These licks were discovered by two members of the party fifteen years before, when a yacht in which they were cruising ran on a reef. While awaiting the assistance of a tug the island was visited, where numerous caribou tracks about muddy pools indicated the presence of salt springs. It was due to this rather ancient record that we expected to find the moose as successors to the caribou at these resorts, which calculation proved correct. What the camera captured is best told by some of the illustrations accompanying this article.

In a week one hundred and fifty moose were seen, all apparently depending upon water plants for support, the numerous ponds and lakes yielding a sufficiency, though often the animals were forced to feed in water well over their backs, as they dived out of sight in search of food (see page 162).

Only on the face of inaccessible cliffs was the vegetation undisturbed, and just how these animals survived the long winter, when the waters were closed, was a problem, though many of them may have crossed to the main shore and returned in the spring. In a patch of spruce were discovered two large pairs of interlocked moose antlers, where these animals, in the fierce rivalry of the mating season, had gone down in mutual defeat forever (see page 161).

At the time of our visit no one was living on any of these islands, but nearby inhabitants supplied themselves with moose meat regardless of the law, justifying it on account of war conditions. At a salt spring several hundred yards back of the camp I located the first blind, where it was disturbing to see a four-year-old bull moose lying dead within thirty yards, killed but a few hours before and abandoned by reason of our proximity. Here, festering in the sun, it soon drove away any of its surviving associates (see page 159).

MOOSE DIG A BASIN OF CLAY AT SALT SPRING

Several days later another blind was placed opposite one of the best natural licks I have ever seen, located a mile up the stream from the first. Here the moose during many years had dug out a large clay basin, into which trickled a salt spring from the adjoining bank, the mixture resembling liquid mortar.

Every time we passed the place one or two moose would leave hurriedly, but a trial in the daytime showed that the scent circled toward the lick, covering every approaching runway; so a flashlight and camera were set up, and on the night following a large cow moose took its own picture at a distance of fifteen feet. The analysis of this salt lick is given in the text beneath the picture (see page 164).

On several islands adjoining, the moose were numerous and tracks proved the

presence of a considerable number of caribou. All these animals visited licks similar to those on St. Ignace. On the opening of the hunting season, the same fall, one party of five from Port Arthur killed their limit of five big bull moose on the first day of the hunt, the antlers ranging in spread from forty-eight to fifty-four inches. The question uppermost in the author's mind is whether any of the fine bulls pictured in this chapter furnished some of these trophies.

Just as the south shore has been almost depleted of its trout by taking them at the mouths of all the spawning streams during their fall migration, similar conditions now prevail on the north shore, while a worse habit of running the gill-nets to the beach, ostensibly set for lake trout and whitefish, results in taking all the speckled trout exceeding two pounds in weight, and soon only the Nipigon, always under rigid government supervision, will remain.

CHAPTER X

WILD LIFE IN AND ABOUT THE CAMP GARDEN, WHITEFISH LAKE

In a previous issue of this Magazine* reference was made to the large number of birds and animals visiting the clearing and log cabins of a wilderness camp; for such a place is often an oasis in a dense and monotonous forest, where sunshine, wild berries and seeds, shrubbery and ground vegetation, insects, and small rodents offer food or a trysting place to many a creature outlawed by man.

Mention, too, was made of smaller and less timid animals which came at night to the gardens and poultry yards of many a rural home, especially when there are thickets, swamps, or rocky ravines in the vicinity. The tenacity with which these refuges are occupied by certain wild animals in the midst of encroaching civilization is an interesting study in resourcefulness and adaptability, wherein reason plays a part quite as important as that of instinct.

For nearly thirty years my camp was occupied only in the fishing and hunting season, followed by intermittent or long

* See "Wild Animals That Took Their Pictures by Day and by Night," July, 1913.

periods of disuse. On returning, there was varied evidence of of many woodland visitors, for here, in a sunny spot, would be the daily dusting place of the grouse; everywhere were the hoof-prints of deer and occasionally the dog-like tracks of a skulking wolf, unafraid of a hunter's cabin when a fresh trail of a deer gave assurance of a long-absent owner.

There were door-sills and pork barrels gnawed by the saline-seeking porcupine; the broken branches of a mountain ash where Bruin leisurely pulled down red clusters of frost-sweetened berries; the tender saplings girdled by a varying hare; clover and dandelions cropped close by bulky woodchucks; the pungent odor of a skunk beneath the cabin floor, and tracks of the great blue heron, mink, muskrat, and the beaver on the sand-bars of the creek flowing through the camp lot.

STUDIES IN ANIMAL PSYCHOLOGY

Perhaps the first night there would be a chorus of indignant owls within the glare of the camp-fire or the startled snort of an approaching deer. Then all would change. For the circling smoke, the heavy blows of the axe upon the hardwood logs, human voices, and the telltale scent gave distant warning of the enemy's return.

Except for the twittering of the chipmunk, the tattoo of the woodpeckers, and the flight of cedar birds and bluejays across the clearing, or the scamperings of the white-footed mice upon the cabin floor, all the more timid birds and animals would disappear.

The difference between the time when there was neither a habitation nor a rail-



Photograph from George Shiras, 3d

A BEAVER EYEING THE OUTFIT WITH SUSPICION

Sometimes the thread, as above, runs to the base of the tree, showing the beaver making a preliminary circle before starting to work; in other cases the thread is attached just below the cutting, picturing the animal erect (see page 178).

road within twenty miles (see page 124) and when a more accessible camp was enlarged and a caretaker continuously in charge affords one of the most interesting chapters in animal psychology within the writer's experience.

It might well be supposed the eviction of forest visitors was final when the place was occupied by day and night, with all the noise and bustle of a woodland home, for the chorus of barnyard fowls, the neighing of horses, the lowing and the tinkling bells of browsing cattle, the chug of an engine filling the garden tank, the circling smoke, and the glittering lights seen afar each night gave ample notice to every living thing that man had invaded their domain and intended to abide therein throughout the year.

THE CAMP BECOMES A RENDEZVOUS FOR FOREST FOLK

But just the contrary happened. The deer soon found that their ancient enemy preferred a camera to the gun, and, freed from the terror of prowling wolves, took



Photograph by George Shiras, 3d

A BEAVER (AT LEFT) FILLING IN THE SLUCEWAY OF THE OLD LOGGING DAM
(SEE PAGE 198)

After the sluceway had been two-thirds filled with water-soaked logs and sticks, it was completed by intertwining bushes and water-grasses, with a stone or log to hold them down.

possession of swamps and near-by thickets. The grouse knew the fox and lynx were equally cautious, and nested contentedly at the edge of the clearing.

Robins, safe from hawks and owls, built numerous nests in the scattered balsam, finding angleworms and berries for their clamorous broods. The night-loving hare nibbled on the clover beneath the midday sun (see page 168); the muskrats had trails straight from the creek to the nearest carrot patch; porcupines chiseled the tender bark of many a sapling; once a beaver gnawed a half-grown ash by the boat-house and only retreated when the flashlight recorded a midnight visit (see page 167).

Raccoons knew when the corn was tender, and again the flashlight saved the crop; skunks dug holes beneath the stable floor and now and then picked up a belated fowl; a mink, grown tired of a diet

of fish, took heavy toll of the snow-white ducks in the swimming-pool (see page 166); chipmunks found the little potatoes just the things for carrying off; cherry birds gladly changed from the wild to domestic fruit (see page 123), and all day long woodpeckers, nuthatches, catbirds, and jays picked at the suet hung conveniently near.

Humming-birds and butterflies flitted among the flowers, beneath which sat little green frogs sure of a meal (see page 174); the blue heron stalked at the edge of the stream (see page 169), and none ever had reason to regret a camp wedged in the mighty forest, except those seeking the lives of harmless creatures.

THE DEER AS MIDNIGHT VISITORS

The most interesting as well as the most destructive visitors were the deer, for as the gradually enlarging garden



Photograph by George Shiras, 3d

BEAVER WORKING ON SUBSTRUCTURE OF THE DAM THREE FEET BELOW THE SURFACE

This scene represents one of the many beavers that, for the past six years, have endeavored to fill in the sluiceway of the lumber dam above the author's Whitefish Lake camp (see page 108). This beaver fired the flashlight when he was several feet below the surface. Body takes white, oil on hair reflecting light. Note the hair separated in strands by the current.

offered a greater variety of vegetables and small fruits, the temptation proved irresistible.

When the garden patch was a simple one, and unguarded before the hunting season, the bucks were formerly active in these forays; but few came later, the gallantry of the mating season sometimes inducing an antlered escort to jump the fence over which had already gone his less timorous partner.

Does, fawns, and yearlings, totaling some seasons more than a dozen, each night or so registered their presence and respective ages by the clear-cut hoof-prints in the garden soil. Rarely did one come before midnight and seldom were any seen in the vicinity during the day.

In the past decade a record has been kept of the vegetables and fruits most preferred, with a notation when there

was a marked departure any season by groups or individuals.

RASPBERRY BUSHES FIRST VISITED BY DEER

Not until the fawns were free to follow their mothers and the garden offered the first of the ripening crops would there be a visitor. On or about the middle of July the wild raspberry bushes close by the fence showed a clipping of the newer growth, followed by a nibbling on the tender bark of border fruit trees. A few days later, when the darkened windows gave assurance that the occupants had retired, the vegetable patches close by the cabins were visited.

In the order of choice, and somewhat determined by the rate of growth, came the carrot and beet tops, lettuce, and new shoots of domestic raspberries, white clover, peas, Brussels sprouts, and white



Photograph by George Shiras, 3d

A CONVENTIONAL HOME OF THE MUSKRAT

A type of house built by all muskrats in shallow, marshy waters throughout the country. This presents a view of the slough much frequented by deer (see page 127).

and red cabbage, the last mentioned, by reason of its sweetness, preferred above all else.

None ever touched the leaves or products of the potato plant, tomatoes, squash, rhubarb, corn, cucumbers, asparagus, onions, or parsnips, and the escape of the latter was inexplicable. Some seasons their attention was almost entirely devoted to the strawberry plants, and then the next year not a leaf or a tender runner would be touched.

FLASHLIGHT TEMPORARILY DETERS ANTLERED MARAUDERS

In the endeavor to save the cabbages, they were always planted within a few feet of the caretaker's bedroom; but often in the morning a great gaping hole in the center of a head showed what was considered the choicest morsel and willingness to take a chance.

Partly to save the crops and, in my own case, more to record the presence of the most cunning of our antlered animals, the flashlight and cameras were put in different parts of the garden, with a cabin or some camp shelter as a background when possible. More than fifty such pictures have been taken, a few of which accompany this article (see pp. 170-173). The heavy report and dazzling glare terrified each marauder for a week or two,

and then, led by hungry and less timid fawns, they returned again to the feast, where on moonlight nights their shadowy forms might be seen moving noiselessly from place to place.

MUSKRATS MAKE A FORAY ON PARSNIPS

As another means of saving a portion of the crops intended for winter use, each on reaching maturity was placed in the root-house, except on one occasion the parsnips, which, never having been molested, were left in the ground, well covered with four or five feet of snow. It was the intention to dig them out early in the spring, when they would be in a better and sweeter condition than if placed in the root-house.

In the spring, as the deep snow began melting, a hole was dug down to the soil for a first meal on the parsnips, when a tunnel, with branches leading 200 feet to the water, made by muskrats, was found and not a vegetable remained! This showed very plainly the habits of these animals in venturing far from the water-courses and beneath the deep snows in search of green food untouched by frosts or zero weather.

SUMMER RESIDENT BIRDS ABOUT CAMP

In addition to the birds already mentioned within the camp inclosure and the



Photograph by George Shiras, 3d

IMITATING THE BEAVER HOUSE

A large muskrat house constructed entirely of sticks and mud, closely resembling in shape and material that of the beaver; south end of Whitefish Lake.

vicinity, a large number have been omitted which may now be noted in order to complete the record. No migrant passing to the north or returning in the fall is included, but only those found nesting or in company with young too immature to have crossed Lake Superior. Among the birds are the following:

The hooded merganser, mallard, black-duck, wood-duck, bittern, great blue heron, solitary sandpiper, spotted sandpiper, and killdeer; the hawks include Cooper's, the red-tailed, broad-winged, and the sparrow-hawk, and the owls are the barred and the western horned, both winter residents. Among the other birds are the black-billed cuckoo, belted kingfisher, hairy and downy woodpeckers, yellow-bellied sapsucker, northern pileated woodpecker, flicker, nighthawk, chimney swift, ruby-throated humming-bird, kingbird, phoebe, olive-sided flycatcher, wood pewee, alder flycatcher, least flycatcher, cowbird, meadow lark, bronzed grackle, purple finch, goldfinch; and the sparrows are the vesper, white-throated, chipping, field, song, and the Lincoln sparrow (doubtful), together with the slate-colored junco, the rose-breasted grosbeak, barn swallow, tree swallow, cedar waxwing (see page 123); and the warblers are the black and white, black-throated blue, myrtle, chestnut-sided, Blackburnian, and black-throated green warbler, the list con-

cluding with the oven-bird, Grinnell's water thrush, house wren, white-breasted nuthatch, chickadee, olive-backed thrush, and bluebird.*

CHAPTER XI

THE BEAVER AND THE MUSKRAT: A COMPARISON

Conspicuous among the few North American animals which have no representative in the Old World is the muskrat, its fossil remains being found in Pleistocene deposits in many parts of the United States, while the beaver belongs to a more remote time, its ancestors going back to the Tertiary period, when they were associated with the mastodons and mammoths throughout portions of Europe and Asia.

Considering the early importance of the beaver as a source of fur and food, and the respect shown its skill in constructing dams and houses, in cutting

* This list was verified by Mr. Norman Wood, field naturalist of the Michigan University Museum, who spent the spring and summer of 1918 at the author's camp.



Photograph by George Shiras, 3d

MUSKRAT HOUSE WITH A CORRIDOR

For five years, at least, a pair of muskrats have used this hollow log as an entrance to their winter home, which is rebuilt each fall on top of the log. A hole in the upper part provides an entrance (see also illustration on opposite page).

and storing its winter food, or wariness in avoiding the multitude of methods designed for its undoing, it is not strange that this animal figured in the tribal ceremonies of various Indian tribes and was exalted above other animals.

Both of these aquatic fur-bearers belong to the order of rodents, the beaver being the sole representative in the family *Castoridae*, while the muskrat, once associated as a genus in the same family by Linnaeus and others, has been demoted by later scientists and assigned to the rat and mouse family, the *Muridae*, consisting of more than a thousand species and variants, widely distributed small animals, including many useless and destructive "varmint."

THE CINDERELLA AMONG FUR-BEARERS

To the properly descriptive prefix "musk" was appended the derogatory term "rat," making it a Cinderella among the fur-bearers and an outcast for many

years in fashionable circles. With the gradual recognition of the high value of its fur, mostly under fictitious trade names, its caste has improved very greatly of late. Without entering into a discussion concerning the structural differences between the beaver and the muskrat, it is interesting to note their general resemblances in appearance and habits.

These animals are similar in shape and color, in the double coat of hair, webbed feet, flat, scaly tails, in having peculiar gland secretions and other anatomical resemblances. In habits they are homogeneous, being aquatic, nocturnal, monogamous, living in houses or burrows within the banks, each constructed and occupied in much the same way, often as harmonious cotenants, while their extensive range is the same in North America.

There is a marked similarity in the food habits of these animals. Very many



Photograph by George Shiras, 3d

A COMPLETED MUSKRAT HOUSE (SEE ALSO ILLUSTRATION ON OPPOSITE PAGE)

This flashlight shows the pair of muskrats putting the finishing touches to their home.

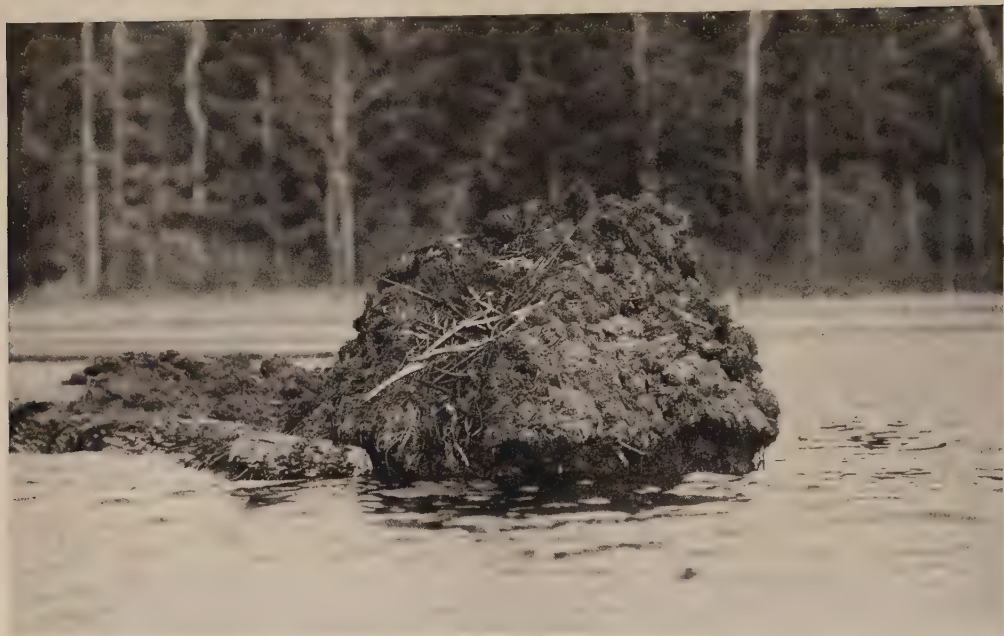
suppose that the beaver primarily depends on bark, and that such soft vegetation as it feeds upon is incidental and irregular. This is an error, for the beaver in its extensive ranges relies upon bark only during the months when other food cannot be easily obtained or stored.

By adaptation to the seasonal food supply, the beaver resorts to the more perishable aquatic growths from May to October, and to the many varieties of land plants, bushes, and vines, thereby conserving the arboreal supply for a time when the deciduous plants yield to the frosts or gradually chilling waters. In higher altitudes, where spring or glacial streams are often too cold for vegetation, the beaver depends upon bank willows, weeds, and the other small growths, though occasionally the bark of poplars or birch is eaten at the base, the tree seldom being cut before fall.

Prior to 1700 the beaver was seldom molested by the Indians of the upper lakes; for, aside from decorative purposes, they preferred larger skins for domestic use.

The early explorers found the usual meadows and alder-covered flats, where the original forests had been killed by the flooding caused by beaver dams; but, as the watercourses were fringed almost entirely with conifers, the lake region in the beginning was not a particularly good beaver country. When the aquatic plants, willows, alders, and black ash, constituting their principal diet, became exhausted, the animals migrated elsewhere, and thus these cycles of occupation and abandonment were regulated entirely by the question of food.

On the arrival of the trappers it did not take long to reduce these numerous but scattered colonies, and for a hundred



Photograph by George Shiras, 3d

MUSKRATS LIKE HOUSE-BOATS

A cedar raft built for the muskrats to use as a float for their winter home. Anchored in the slough at the south end of Whitefish Lake and now in use three years (see page 196).

and fifty years there was a succession of good seasons, followed by a relapse.

A NOTEWORTHY STUDY OF THE BEAVER

When the writer first came to Lake Superior not one stream in a dozen showed any recent signs of beaver, most of the animals being found at the headwaters of the streams and on little lakes well inland, where the Ojibways never lived and the white trapper sometimes overlooked them.

In 1867, three years before my arrival, there appeared in print a monograph on "The American Beaver and His Works," by L. H. Morgan, the most original and valuable biography ever written about this animal, and still regarded as a classic in zoölogic literature. Mr. Morgan resided in Marquette County for a number of years, associated in the building of railroads and furnaces. On his many trips into the woods he always employed Jack La Pete as his principal guide, and from the latter I learned much about this indefatigable investigator.

Mr. Morgan's collections of skulls and bones led us to nickname him "the fossil"; for, boy-like, we thought such relics

savored of mental antiquity. It is now a pleasure to join in the public commemoration of this remarkable production and to be able to note the great changes taking place in the same localities he visited.

About 1885 the last beaver disappeared from the waters about camp, and for twenty years thereafter none was seen. Finally, a long closed season saved the remnant in upper Michigan.

Six years ago I found fresh cuttings and later located a beaver burrow deep within a bank at the south end of the lake. The next year in enlarging the chamber it broke through the surface soil, which was then covered with a mass of sticks.

HARD TIMES IN THE BEAVER WORLD

The same fall the eviction of the two-year-old beaver led to the establishment of a colony on the river not far above camp, where a large house was built of sticks and covered with mud (see page 180). This new home, however, was not finished until the middle of November, when the ice prevented the collection of the winter supply of food.



Photograph by George Shiras, 3d

BEYOND REACH OF WOLF, FOX, OR LYNX

A raft similar to that shown on the opposite page, anchored in ten feet of water, where it swings freely with the wind. These floating foundations permit the building of the superstructure a month earlier than where the animals are delayed through the fluctuating levels of the lake each fall. One raft house is built of moss, the other reeds.

The next year their plight was disclosed by the stumps of half a dozen black ash cut five feet above the ground, indicating the snow level at the time of their desperate harvesting. In the spring the melting of ice released and brought to the surface a large number of yellow lily roots, some of them six feet long, from which the tender shoots and the outer covering of the roots had been removed, indicating the beaver had passed beneath the ice-covered stream to the lake in search of food at a time when zero weather may have prevented forays above ground.

No lumbering having been done on the river and lake except the removal of a few large pines, there was an absence of all second growth, the beaver depending largely upon the long stretch of black ash bordering the river and parts of the lake. After the smaller trees had been cut, the remainder, varying from 40 to 90 inches in circumference, came next.

When the river colony was estimated to contain eight animals, there were two seasons, 1918 and 1919, during which from 25 to 30 trees were in the process of felling at the same time, showing that few, if any, of these animals continuously confined their efforts to a single tree until

the work was finished. On an average it took from ten to fifteen days before large trees were felled, by reason of this intermittent cutting.

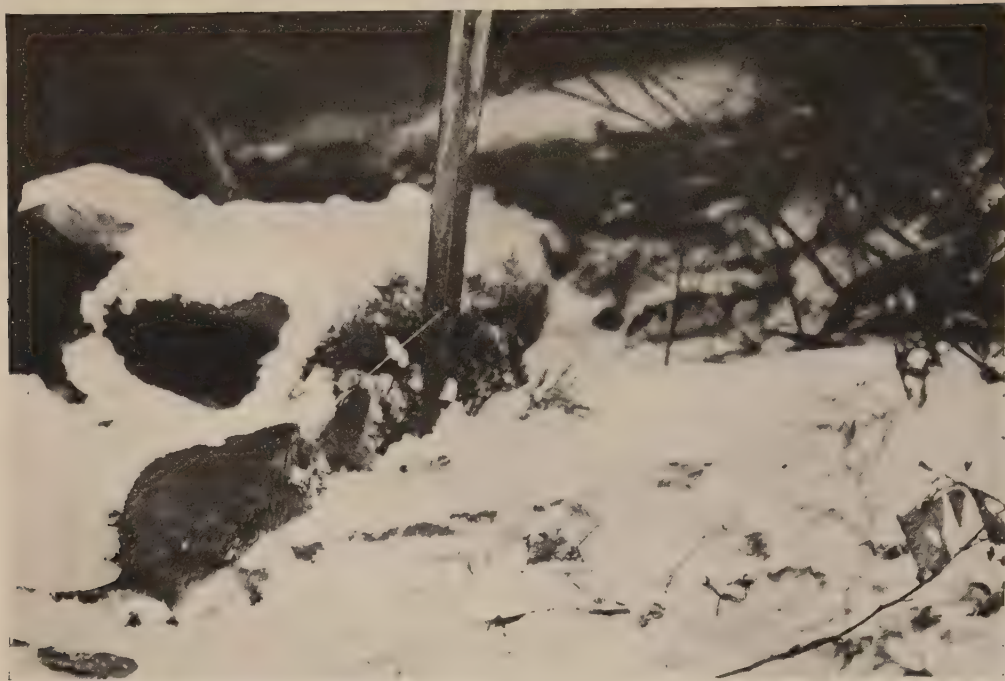
BEAVERS WERE NEVER SEEN IN DAYTIME

The beavers on the river were never seen in the daytime, for the narrow and shallow waters deterred such excursions, but on the lake it was not unusual to see some swimming about late in the afternoon.

It was some years before this, in October, 1912, and on a stream west of Marquette, I got a flashlight of a beaver repairing a dam which had been broken during the afternoon, for the purpose of getting a night picture as the animal attempted its repair (see page 177).

But those about camp had no dams, or at least were not permitted to block the river with one, and consequently the idea of taking a flashlight picture while a tree was being cut seemed to offer the best chance. For three weeks an outfit faced a half-cut tree without result. So, on departing for the East, I told John to leave the camera out a few days longer.

A night or two later a loud explosion was heard up the stream and the undeveloped plates were sent me with the hope



Photograph by George Shiras, 3d

FIRST COME FIRST SERVED

Here a pulling string connected with a flashlight and camera was baited with carrots and fish; for either muskrats or mink. The muskrat fired the flash first, and later a mink removed the fish, as shown by its tracks in the snow the next morning.

that a beaver would be found at work. This proved to be the case, giving much encouragement for continuation of the efforts the next season (see page 178).

While luck varied during the ensuing years, it was not long before I had a dozen or more pictures showing some of the animals erect, busy gnawing away, and others walking about at the base of a tree (see page 183).

PHOTOGRAPH SOLVES A PROBLEM

These photographs made possible the determination of the much-mooted question whether more than one beaver assists in the cutting of a tree. In not a single instance was more than one beaver shown at work or in the vicinity of the tree, nor was that tree touched again during the same season.

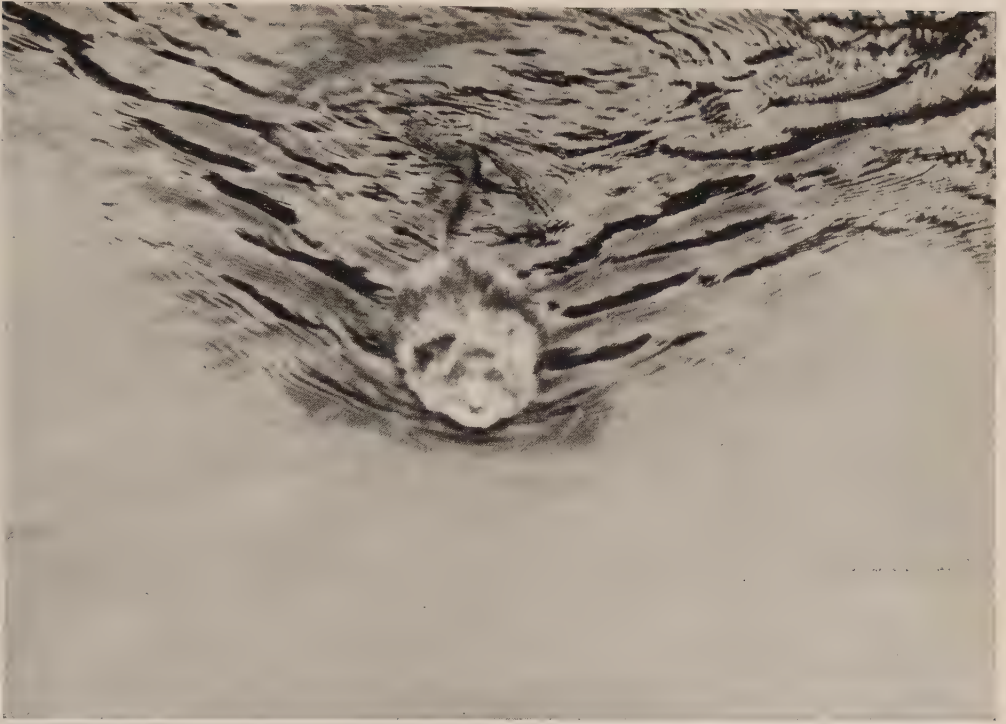
From the very beginning, the river colony tried every fall to block the sluiceway in an old lumber dam several hundred yards above camp by filling it with water-soaked logs and branches, the purpose being to flood the river bottom when cutting down the tree.

Each fall and to the present time it has been a case of "pull out in the morning and fill in at night." This effort to utilize the dam was a very practical conception, only it conflicted with prior rights at camp by preventing access to the lake (p. 190).

This almost daily removal of a great mass of sticks and brush caused John to figure on some way of discouraging their nightly activity, so a lighted lantern was placed in the middle of the dam, with the expectation that this would end their endeavors. The first night the plan was a success, but on the following one the animals were busier than ever. Then the lantern was lowered to the surface of the water, and they paid no attention to it whatever.

WATCHING THE BEAVER AT WORK AT NIGHT

Taking advantage of this situation, we visited the place at night to witness the beaver at work. Such a close view and under a strong light revealed perfectly their methods of construction; so a night later the flashlight and camera took our



Photograph by George Shiras, 3d

A MUSKRAT HEADED FOR THE CARROT PATCH (SEE PAGE 192)

The muskrat differs from the beaver by swimming with its body well above the surface. Contrast this photograph with that of the beaver on page 186.

place, in order that the scenes visible to a few might be put in a permanent and more available form (see page 177).

In 1919, after the beaver became abundant in a number of upper Michigan counties, the season was opened, resulting in all the trappers concentrating in these localities and in the rapid decline of the new-comers. A much better policy would have been the trapping alive any surplus and the distribution in those districts containing hundreds of thousands of acres of worthless second growths along the banks of streams and lakes where the beaver had not yet come.

Such a system, in a few years, would enlarge the beaver population to a point probably never reached in the region before; for the greatly increased food supply and well-balanced regulations in trapping would regulate and perpetuate a contribution of nature such as man never attempted before on such a suitable range.

The muskrat is much more versatile in the variety of its retreats than the beaver, possibly because of its smaller size.

Often it takes possession of the overhanging and lower portions of a beaver-house, living there in peace with the larger landlord, or it may use the wing of any old lumber dam for an all-year home.

THE ABODES OF THE MUSKRAT ON
WHITEFISH LAKE

The muskrats of Whitefish Lake have an unusual number of domiciles; for, in addition to those already mentioned, they resort to hollow logs with an entrance under water, or tunnel beneath a fallen trunk extending beyond the bank, this latter retreat being, I believe, a very common one.

One morning, on a Wyoming lake, I found a pair of muskrats asleep in a newly made nest of grass beneath a flat-bottom rowboat, where the bow extended above the water, and two succeeding nights the same thing happened. Such a home is easily constructed, besides being warm and secure.

The logs along the shore are often the



Photograph by George Shiras, 3d

MUCH ENGROSSED

Daylight picture of a muskrat on the edge of new ice, feeding upon moss taken from the bottom of the lake.

foundation of the superstructure, and in one instance the animal entered the hollow end and then, through a hole in the top of the log, reached the house (see page 194).

A MUSKRAT HOME ON A RAFT

Probably the strangest of all these homes are depicted on pages 196 and 197, where the animals used large rafts anchored in the lake and put there for that purpose by the writer.

Sometimes the house material used by the beaver and muskrat is completely reversed, for when reeds and moss are scarce the muskrat occasionally builds a house out of sticks and mud (see page 193), while the beaver, in a prairie country, has been known to construct its lodge entirely of aquatic vegetation, resembling that of the muskrat except for its size.

Both these animals are particular in having one or more entrances to their homes beneath the water, and when the water recedes the canals are deepened, so as to maintain subsurface approaches.

The muskrats of Whitefish Lake have a habit of building small houses out of moss on the ice-covered lake, using them as resting and feeding places when seeking water plants in the winter.

In many parts of its range the muskrat is supposed to raise from three to four litters a year. Along a great portion of the southern shore of Lake Superior I have never seen any evidence of more than one set of young a year. In this section occurs one of the deepest snowfalls of the country, and this unusual condition doubtless affects the muskrat.

About Whitefish Lake the waters remain cold and high until after the middle of May, when vegetation responds rapidly to the many hours of sunlight. The first young are seen the middle of July, and from that time on until the early frost or the coming of the ice I have never felt sure of having seen the young of a second litter.

THE EDIBILITY OF THE MUSKRAT

In recent years the flesh of the muskrat is becoming more and more esteemed. Its unfortunate surname—rat—has done more to excite a prejudice against its use than all the other causes combined, especially among the feminine members of the family.

Its meat is dark red in color, fine-grained and tender. According to the Biological Survey, any unfavorable opinion as to its flavor arises, probably, from



PORCUPINE AND VARYING HARE TAKING THEIR OWN PICTURES AT NIGHT

Rock-salt was placed between stones, to attract the deer. When the flash was fired, the developed plate showed in front a salt-loving porcupine, while in the rear is a varying hare, of similar taste, in the act of running into a string attached to the stake behind.



Photographs by George Shiras, 3d

DIFFERENT VISITORS ON THE FOLLOWING NIGHT: WHITEFISH LAKE

To prevent small animals firing the flash, as shown in the picture at the top of the page, a balsam top was placed over the salt, raising the string several feet, where it was not so noticeable in the mass of branches. Such contrasting and unsuspected scenes illustrate the fascinations of the automatic flashlight



Photograph by George Shiras, 3d

THE BANK ON THE LEFT, COVERED WITH SECOND-GROWTH TREES, IS AN ANCIENT BEAVER DAM 1,500 FEET LONG, PROBABLY 400 YEARS OLD, AND FORMING THE LAKE ORIGINALLY

The picture shows the western end of Echo Lake, which occupies a mile in the center of Grand Island. It is largely frequented by deer and elk.

the lack of skill in cooking or from carelessness in skinning the animal. It can be fried, roasted, or stewed, only having a slightly gamy flavor, which can be removed by soaking the meat over night in salt water.

I have found it comparable to tender chicken. For years it has been served, highly seasoned and flavored, under the name of "Maryland terrapin," without exciting any suspicion on the part of connoisseurs, who pay a fancy price for it. The use of a few terrapin bones in the dish when served has likely aided in this deception.

In some of the Eastern States the carcass brings from 30 to 40 cents, more than double the price once paid for its pelt. It seems unfortunate, therefore, that several million pounds of available food must go to waste annually; yet for many years its coat was rated among those of the humblest of fur-bearers, and at times the traders of the North refused to take them from the trappers, the skins being practically valueless in the market.

In recent years the really beautiful fur of these animals has become more and more appreciated.

In 1920, at the crest of high prices, muskrat skins were sold in fur auctions up to a maximum price of \$7.50 each. Today the muskrat, on account of the enormous number of its skins and their appreciated price, has become the most important of North American fur-bearers.

Thus it is apparent this American fur-bearer has reached the top in the total value of its pelts and in striking contrast to its status a few years ago.

Restore to it the old Indian name of musquash and the prejudice against the use of its fur or its flesh for food will rapidly disappear.

BIRDS AND ANIMALS MULTIPLY IN CUT-OVER AREAS

Partly because the subject has seldom been considered in print, and again because its significance is so little understood, the wonderful part that second-



Photograph by George Shiras, 3d

A UNIQUE NIGHT PICTURE OF A LYNX

This animal can seldom be photographed in the daytime and at night has a strong aversion to artificial light. In this instance, however, the subject sat erect on the edge of the bank watching the approaching jack-light, its reflection in the water doubling the image. Taken on a small lake in western Ontario.

growth vegetation in deforested areas plays in the distribution and relative numbers of birds and animals is worthy of further comment.

In the thousands of miles of wilderness surrounding Lake Superior, the present conditions, so far as Nature is concerned, are better for its wild life than before the coming of the white man, centuries ago; for there is a larger and greater variety of food and better shelter than ever before—two great factors in a suitable habitat.

Other factors of importance are the favorable climatic conditions which about Lake Superior are stabilized and devoid of extremes through the influence of the deeper waters of the lake which remain close to 39° throughout the year. The prevailing northwest winds of summer are cool and bracing, without rain or noticeable humidity, for the warmer and drier air ashore readily absorbs the moisture in the air from the lake, producing the exhilaration of high altitudes, free from the heart strain of a rarefied atmosphere.

Once unbroken evergreen forests covered much of the land. Back from the waters the tops of the towering pines and hemlocks, interlocking, excluded the warm rays of the sun and the bountiful dews; so that only a scant vegetation struggled in the perpetual shadows and in the sour soil, brown with the successive fall of needles.

In these primeval forests there was little food or shelter, for the giant trunks were almost limbless to the green canopy above. In the other sections, where hardwood forests predominated, conditions were equally unpropitious; for neither tender bark, leaves, nor budding branches were in reach of browsing animals.

In the early lumbering operations only the largest trees were cut, the removal hardly leaving a trace, and when one passed through this densely timbered land he seldom expected to see a living thing beyond, perhaps, a porcupine, a red squirrel, or a woodpecker drilling on a dying tree.

Finally came the period of intensive lumbering, where trees of every kind yielded to the axe or went down beneath the crash of a larger neighbor.

Many times came the warning from experienced hunters that the game was doomed; for the sight of cut-over land piled high with wreckage, the discarded limbs smothering all vegetation and discouraging any of a different kind, certainly gave color to these views. But in a few years fires or decay prepared the devastated areas for a new growth, giving assurance of better things.

Where once stood solid forests of pine, cedar, balsam, and hemlock, these were reproduced, the young trees, however, being low-branched and thick, blocking the driven snow and cutting winds, thus sheltering the game from the eye of man and putting food within easy reach.

LARGE CLEARINGS CREATED

Later came the removal of the matured hardwood maples, in hundreds of tracts of twenty to forty acres, creating clearings of unusual size, where the succeeding deciduous growths differed greatly from the original stock, consisting of rapidly growing trees like the poplar, white birch, cherry, alder, and mountain-ash, interspersed with a great variety of berries and low-growing plants, including clover and timothy, introduced by the wind-scattered fodder of many a logging team.

Here came the deer, rabbits, bears, grouse, and hundreds of berry- and insect-eating songsters, many of them new to the land, while the beaver took possession of streams and lakes bordered with these new growths.

In this region Nature, despite man's grasping ways, provides more abundantly than ever food and shelter for the birds and animals, and these bounties should be met in an appreciative way, making it possible for the wild life of the upper region to continue furnishing its valuable quota in meeting our necessities and in the gratification of our outdoor pleasures.

SOUTH FLORIDA'S AMAZING EVERGLADES

Encircled by Populous Places Is a Seldom-visited Area of Rare Birds, Prairies, Cowboys, and Teeming Wild Life of Big Cypress Swamp

BY JOHN O'REILLY

REACHING southward into the sunshine between the Atlantic Ocean and the Gulf of Mexico lies south Florida, a curious subtropic land unlike any other part of the United States.

It is a land where everybody goes, but one that almost nobody knows. Part of the region is populous, and becomes host to thousands of health-hunters and play-seekers each winter.

The other part is a vast area, rich in natural beauty and wild life, which lies beyond the eye of the visitor or winter resident—lies there in the hot sunshine almost unchanged since four centuries ago when Juan Ponce de León penetrated its somber forests as a likely place to find the Fountain of Youth.

South Florida visitors follow a route skirting either coast, where they see streamlined cities and towns of white buildings, bright gardens, and streets ornamented with orderly rows of man-planted palm trees.

Throughout each year thousands speed along the Tamiami Trail, the only highway built across the wide stretch of wilderness between the two coasts, but seldom does one of the travelers wander more than a hundred feet north or south of the highway (map, page 118, and page 122).

HAUNT OF BEARS, BIRDS, ALLIGATORS

Barred from the road by junglelike growth are vast cypress swamps, where wild orchids decorate the aisles of trees, and exotic water birds rear their young in huge rookeries; islands where pines and palms grow side by side, where panthers, bears, and wild turkeys are still found, and alligators dig caves in the soft soil (p. 138).

Spreading out for mile upon mile are the Florida Everglades. To the south they extend all the way to Cape Sable and the mangrove islands at the spearlike tip of the peninsula. Beyond eye range of the visitor are vast areas strewn with the white skeletons of trees, torn and twisted by the power of the winds, and thousands of islands and wide prairies seeming more like a part

of the South American pampas than a section of the United States.

To the north the Everglades stretch all the way to the Kissimmee Prairie and Lake Okechobee, Florida's inland sea. The prairies are low, sandy, grassy, and comparatively treeless tracts, subject to occasional inundation in rainy seasons.

The human inhabitants of the interior of south Florida blend with its untamed atmosphere, for the Seminoles are the only American Indians who have never, since the end of hostilities, signed a formal treaty with the United States Government.

They constitute an independent remnant of a tribe which fought the United States Army in two of the most furiously contested wars ever waged by Indians (1816-18 and 1835-42).

SEMINOLES SECEDED FROM GEORGIA TRIBE

Originally the Seminoles were a group of Creeks who left the main Georgia tribe about 1750 to make their home in the wild country of the Florida Peninsula. "Seminole" means "seceder" or "runaway."

By treaties in 1832 and 1833, some of the tribal leaders ceded their lands to the Government and agreed to be moved out to the Indian Territory in the West. This caused a split in the Seminoles; part of the tribe refused to be moved west and sought sanctuary deep in the swamps (page 130).

Efforts to force them to move brought on renewed warfare, which began in 1835, lasted for seven years, and cost the lives of nearly 1,500 American soldiers and millions of dollars.

More than 4,000 Seminoles and runaway negroes who had become their slaves were transported to the West in small groups during those seven years, but a small number held out to the last, protected by their knowledge of the swamps and their ability to live in them. The war ended in 1842 without a treaty. Today about 650 Seminoles still make their homes in the Everglades and the cypress swamps.

Reservations have been provided for



Photograph by Luis Marden

TO SPEAR GARFISH, SEMINOLE TRIBESMEN STAND BY THE HOUR LIKE STATUES

One young fisherman is pulling in a prize. Along the Tamiami Trail, Indians are commonly seen watching intently for the garfish, which they consider a delicacy.

them, but for many years their only contacts with the white man were when they silently appeared to sell and trade the hides of the animals they trapped in the swamp.

In recent years they have been forced into closer relations because of the draining of part of the Everglades and the growing scarcity of game.

To obtain a livelihood the tribesmen have built villages of palm-thatched huts along the Tamiami Trail. There they exhibit alligators, wildcats, raccoons, snakes, and other animals in cages and charge visitors a small sum for inspecting the village.

For the most part, though, the traveler finds that the Seminoles are still uncommunicative individuals. They accept coins at the village gates but usually refuse to talk with strangers.

When not in villages, they roam the Everglades and the cypress swamps, where they

still hunt alligators for their hides, wandering about in country still almost inaccessible to the white man, where even the old Spaniards did not penetrate frequently.

Pánfilo de Narváez, who followed Ponce de León in 1527, and those who came after him, founded settlements along the coasts of Florida but rarely attempted inland excursions in the swampy south.

THE LURE OF THE SWAMP

Such has been the history of the Everglades since. Cities have grown on either coast, but until the building of the Tamiami Trail (page 122) the swamps were little known. Besides the Seminoles, there are still few who really know them.

To see this strange inland wilderness I went to south Florida. I wanted to view at first hand the curious and beautiful birds about which I had read or which I had seen



Photograph by S. A. Grimes

YOUNG SNOWY EGRETS HUDDLE UNDER THE PARENTAL WING

Once decimated to supply the long, lacy plumes, which were fashionable as hat decorations, the snowy egret is now again becoming numerous in many of its old haunts. Protective legislation and sentiment against the use of aigrettes for ornament have helped the recovery of the species. This nest in the Everglades displays the typical crude construction of dead twigs (page 134).

as lonely specimens in zoos—the roseate spoonbill, the snowy egret, the wood ibis, and many others. I wanted to go far into the big swamps, for swamps have always fascinated me as places where Nature puts on her most abundant show. It was to be a wilderness trip. The cities were to be merely starting points.

My guides were wardens of the National Association of Audubon Societies. Their duties are to protect the bird population of the region and they must know the country they patrol.

The plan was to start in the vicinity of Lake Okeechobee and gradually work southward to the Everglades; then, finally, to invade the great cypress swamps.

As I alighted from the train at Okeechobee City, two men in the olive uniform of the Audubon warden service approached

me. One was Alexander Sprunt, Jr., director of southern sanctuaries for the Association. The other was Warden Marvin Chandler. Their enthusiasm was evident.

There was still enough daylight for me to get a first impression of the Kissimmee Prairie. We piled into Chandler's car, which looked as if it had been climbing trees, and headed out of town.

A TRAILER FOR THE HORSE

As we rode, it developed that the car was used for almost everything. Chandler, of lean and wiry build, is a native of the prairie country. His face is tanned the color of dead palmetto. He is stingy with words, but his mouth is bordered by grin wrinkles. He patrols a wide area and knows it as a housewife knows her kitchen floor.

The warden keeps vulnerable parts of his



SOUTH FLORIDA BLENDS INDIAN VILLAGES AND LUXURIOUS BEACH RESORTS, BIRD-RICH SWAMPS, AND MODERN CATTLE RANCHES

Remote marshes, prairies, and forests of the water-soaked inland are edged, on the Atlantic and Gulf of Mexico shores, with cultivated strips studded with groves, villages, and streamlined cities such as Miami, West Palm Beach, St. Petersburg, and Tampa. The Everglades National Park Association has worked for many years to set aside as a park a large area in the southern part of the State. By Act of Congress in 1934, some 2,000 square miles, outlined by dashes on the map, were allotted for the proposed park. It is planned to preserve in their natural state the wild life, jungles, interlocking waterways, and keys of this tropical region. Between Seminole Indian reservations and Kissimmee Prairie lies Lake Okeechobee.

car so coated with grease that it can almost travel under water. The machine is used where there are no roads or over sandy ruts worse than no road at all.

Usually Chandler hauls a horse in a trailer behind his car. When the going gets too rough, he saddles up the horse and rides on to look after his birds. He says the horse now likes to ride better than he likes to be ridden (page 130).

At intervals during the first several miles, the warden pointed to straight sidewalks stretching out across the prairie, leading nowhere. They were veined with grass-grown cracks and bordered by palmetto. Those sidewalks were concrete reminders of the Florida land boom, marking places where dream cities were to have stood. Now they were being reclaimed by Nature.

After a few miles the car swung off the paved road onto a tortuous trail through the sand, lunging over it with the grace of a jitterbug. Chandler rocked easily at the wheel, keeping his seat like an accomplished horseback rider. His passengers achieved no such synchronization.

OWLS THAT DIG TUNNELS

Suddenly the world became strangely still. My bones settled back into their sockets and my head cleared. Chandler

had stopped the car. Ahead and near the road a small brown owl stood stiffly erect on a mound of white sand. It stared at our vehicle.

It was one of the strangest of avian curiosities, the Florida burrowing owl (*Speotyto cunicularia floridana*), a bird that makes its home beneath the ground like a woodchuck. The owls dig a tunnel four feet or more long and at the end of it hollow out a room for the nest (page 121). They feed almost entirely upon insects. When the young are old enough to leave the nest they sit in a family group on the mound beside the burrow while the old birds forage for them.



© Kurt Severin

LAUGHTER LIGHTS THE FACE OF A SEMINOLE "GIBSON GIRL"

Characteristic of the Indian women of the south Florida "out back" is the carefully molded and net-bound "hair-do." With such an overhanging roll, this ten-year-old girl needs no broad-brimmed hat for protection from the sun.



Photograph from Wide World

THEY TAKE THE SUN ON THE PORCH OF A HOME ON STILTS

If the sea rises too high, they can free their house and float away. Independent residents of Chokoloskee Island, in the Gulf of Mexico off Florida's southwest coast, live over large shell beds left by ancient occupants.

Chandler was engaged in making a census of the nesting pairs of burrowing owls in his territory. He had located 64 pairs since the beginning of the nesting season. It is estimated that there are not more than 500 pairs in the Kissimmee Prairie.

As we got out of the car, the bird flew from the mound beside its burrow, coming to rest some 30 feet away. There it stood contemplating the intruders with an indignant air. Suddenly it bowed quickly from the hips, a brisk bow of intimidation rather than a gesture of courtesy.

While we inspected its burrow, the bird remained near by, bowing at intervals but never taking its eyes from the group at its doorstep. It showed no inclination to fly away and was still watching us as we climbed into the car and jolted on our way.

In time the vast sweep of the Kissimmee

Prairie spread out around us. The flat plain with its brownish-green covering of grass and palmetto swept away to the horizon. Here and there were clumps of thickly set cabbage palms and at times a single one stood like a lonely sentinel. Now and then narrow belts of slash pine were in sight, but for the most part the view was unobstructed.

To me the Kissimmee Prairie had been merely a name on a map. Here was a great stretch of inland Florida, roughly 80 miles long and 40 broad, which most visitors to the State glimpse from train windows as they speed toward coastal resorts. Those who do traverse its few roads by automobile are surprised to find what appears to be a bit of the western cattle country brought east (page 139).

The Kissimmee Prairie is a ranching sec-



Photograph by S. A. Grimes

THE FLASH BULB SURPRISES BURROWING OWLS AT THEIR DOORSTEP

Beside one owlet stands a solemn, wide-eyed parent bird (extreme left). Another young one rests in the entrance to the burrow. Sandy soil held together with grasses forms the favored situation for the home. The birds dig a tunnel four to eight feet long. At the end is the nest, lined with grass roots, pieces of dry cow dung, and bunches of hair. Prairies of central and southern Florida are the burrowing owl's chosen haunts in this State (page 119).

tion. Florida cattle graze singly or in small groups far out on the plain.

Cowboys in boots and big hats drive herds along the roads to shipping points, and disputes arise over grazing rights just as cattle wars were started in the free range days of the old West.

LAST OFFICIALLY RECORDED CAROLINA PARAKEETS

Before the sun had dropped below the straight-line horizon Chandler stopped the car at Taylor Creek Hammock. This grove of live oaks, willows, and other trees along the creek is a spot deeply revered among ornithologists. From here came the last official record of the Carolina parakeet (*Conuropsis carolinensis carolinensis*), now feared extinct. Dr. Frank M. Chapman,

Curator of Birds at the American Museum of Natural History, saw two flocks totaling 13 birds there in 1904. About a dozen are believed to have been seen in 1915 and another 30 in 1920. Since that time there have been only vague reports of them.*

Once these typical parrots flourished in the Eastern States from Florida to Virginia and in summer flocks wandered as far north as Pennsylvania and New York.

We strolled for a time under the live oaks, and I found myself scanning the tops of the

* See "Parrots, Kingfishers, and Flycatchers," by Alexander Wetmore, in the NATIONAL GEOGRAPHIC MAGAZINE for June, 1936; also the National Geographic Society's *Book of Birds*, Volume II. Virtually all species mentioned in this article are pictured and described in that two-volume work, a new edition of which is now available (\$5 the set, postage prepaid in U. S. and Possessions).



TO BUILD THE TAMiami TRAIL, THE ROADBED (RIGHT) WAS CLEARED OF MUD AND THEN FILLED WITH ROCK BLASTED FROM A PARALLEL DITCH

Photograph by G. W. Romer



WESTWARD FROM MIAMI, THE TAMiami TRAIL RUNS FOR MORE THAN 35 MILES WITHOUT A BEND

Photograph by Luis Marden

Cutting across the wild Everglades in southern Florida, the famous highway was named for Tampa and Miami, the two cities which



TWO CAUSEWAYS AND CHAINS OF VERDANT ISLANDS CONNECT MIAMI BEACH (FOREGROUND) WITH MIAMI AT THE EVERGLADES' EDGE

Photograph by Richard B. Holt



Photograph by Aero-Graphic Corporation

FLEETS OF ISLETS CROWD MANY OF THE LAKES IN THE EVERGLADES' VAST AREA OF WATER, FOREST, SWAMP, AND PLAIN

From the air many smooth spots show up as safe landing places for planes but often these "islands" are actually swamps of matted vegetation.



WHITISH BLOTCHES SHOW WHERE POOLS HAVE BEEN DRAINED TO OPEN FERTILE SECTIONS OF THE EVERGLADES TO AGRICULTURE
Photograph by Aero-Graphic Corporation

A new road zigzags into the "frontier" region in the upper right corner. Draining the vast swamp areas of central and southern Florida has raised serious problems. Many marsh birds and other water-loving creatures are deprived of breeding grounds, and in dry seasons the parched land is swept by fierce fires (page 138).



Photograph by G. W. Romer

A HUGE DREDGE EATS ITS WAY THROUGH THE SWAMP

Water hyacinths cover the surface so thickly that the floating construction giant seems to stand on solid ground. At the right, another derrick rests on dry land. The operation was photographed near South Bay on Lake Okeechobee.

trees in the hope that I might catch a glimpse of the bird that had been long since erased from the south Florida wild-life picture. Chandler recalled how he had seen flocks of the parakeets in that vicinity when he used to go there as a boy.

Since none of the birds came back to us out of the past, we returned to the car and headed back toward Okeechobee City.

There followed days of wandering over the wide prairie. Most of the time the car forsook the sandy roads to follow its own course across the plain.

WONDERS OF THE FLORIDA PRAIRIE

Once, far out on the prairie, Chandler stopped the car near a low clump of palmettos. It seemed no different from thousands of other such clumps, but the warden pushed his way through the foliage and

pointed to the nest of a turkey vulture. It was only a shallow depression in the ground, adorned with a few dead leaves and containing a pair of creamy-white eggs, mottled with brown and lavender.

Later the same day we came upon a tall pine tree standing alone. In its top was the nest of a pair of bald eagles, a massive structure evidently inhabited by the birds for years. Some of the sticks used in its construction were like small logs. On its edge perched a single young eagle, peering down at its visitors. As we inspected the nest, the old birds circled us but kept their distance.

That night brought us a thrilling sight, a flock of Florida cranes (*Grus canadensis pratensis*) arriving at their roost (page 136). This bird, larger than a goose, is a close relative of the sandhill crane and is

now rare except here. The roost we visited is the largest in the State, but the breeding season had started and most of the birds had paired off to build their nests in marshy spots.

After winding across the prairie for hours, the car pulled up in the late afternoon behind a stand of tall palmettos. Several marsh rabbits had emerged from hiding. As we took our places behind the palmettos to wait for the cranes to come in, a cottontail sprang from beneath the leaves at our feet.

From our vantage point we kept watch to the northwest because Chandler said the cranes would soon be returning from their feeding grounds along the shores of Lake Istokpoga. By peering over the top of our screening palmettos we could see the shallow pond, along the shores of which the great birds stand during the night.

THE COMING OF THE CRANES

It was getting dusk when Chandler made a motion for silence. From the direction of the lake came the buglelike notes of a Florida crane. Soon a pair of the huge birds approached us, flying low and silhouetted against the sunset. Arriving over the bushes which surrounded the pond, they set their wings, lowered their long, awkward legs, and glided to a landing at the water's edge.

Another lone bird appeared. Soon others began arriving in groups ranging up to seven. When several came to the roost at a time, those already on the ground greeted the new arrivals with a raucous chorus.

Through our binoculars we could see them stalking along the edge of the water, evidently selecting some comfortable spot to stand and sleep. It was just about dark before the last bird arrived. Ninety-three of them had come to the pond. Before the breeding season started, Mr. Sprunt had visited the roost and counted 768.

Leaving the crane dormitory, the car wound back across the prairie through the darkness, the headlights making the landscape even stranger than it had been in the daytime. Chandler found his way about in the dark as well as he did when the sun was shining.

That night the expedition members were guests at the home of W. S. Pearce, patriarch cattleman of the Kissimmee Prairie. Mr. Pearce retired recently and now the ranch, with its thousands of cattle, is operated by his daughters. Their ranch house is in a grove of ancient live oak trees on the bank of the winding Kissimmee River.

Members of the family and cowboys were amused when their visitors insisted on arising at dawn to hike along the river bank and listen to the yelling cries of the limpkins (*Aramus pictus pictus*) in the marshes. The limpkin is a gangling brownish bird with a long, slender bill. It has a cry like that of no other thing that flies—a startled yell. It also startles the listener who has never heard it before.*

At dawn the limpkins were standing like sentries in the edge of the marsh grass and yelling their heads off. Sharing their river-bank habitat were a few snowy egrets, little blue herons, Ward's herons, and a young bald eagle. A barred owl greeted the dawn with hoots from the woods beyond the marsh.

Before leaving the area of Chandler's patrol we decided to inspect the marshes bordering Lake Okeechobee, which provide a home for countless flocks of water birds. As usual, Chandler felt that dawn was the time to start.

Driving to the mouth of the Kissimmee River, we embarked in an outboard motorboat and headed southwest. Looking to the left was like gazing out over an ocean, for no shoreline was visible. Lake Okeechobee is more than 30 miles across. On our right the marsh grass formed a border for the lake, an expanse of green which varied from one to four miles in width.

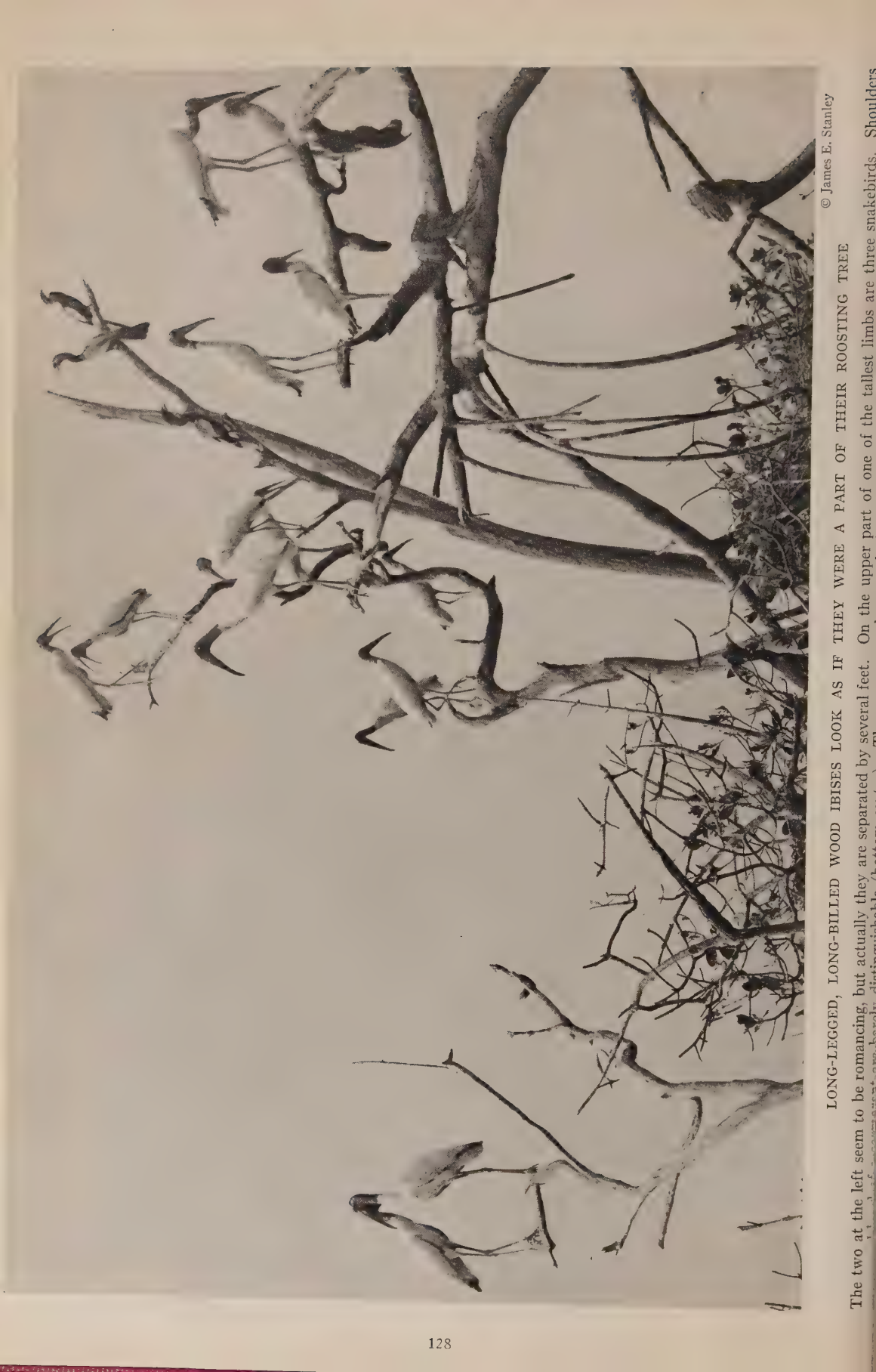
In this undisturbed haven of grass and water the birds had found sanctuary. Their squawking, chattering voices came mysteriously from the depths of the marsh to be heard above the whir of the motor. From time to time they rose in flocks above the forest of reeds only to settle back out of sight, white ibises, little blue herons, snowy egrets, and many others.

OCEAN FISHING RULES APPLY TO BIG LAKE OKEECHOBEE

The only human beings encountered on the lake were fishermen setting out long nets for catfish. So large is this fresh-water lake that it is classed legally as salt water and comes under the same fishing regulations as the ocean.

As the boat passed the mouths of little bays, flocks of coots, widgeon, and other waterfowl appeared. An osprey flew overhead, a fish clutched in its claws.

* See "Hunting with a Microphone the Voices of Vanishing Birds," by Arthur A. Allen, in the NATIONAL GEOGRAPHIC MAGAZINE for June, 1937; also The Society's *Book of Birds*, Volume I.



© James E. Stanley

LONG-LEGGED, LONG-BILLED WOOD IBISES LOOK AS IF THEY WERE A PART OF THEIR ROOSTING TREE

The two at the left seem to be romancing, but actually they are separated by several feet. On the upper part of one of the tallest limbs are three snakebirds. Shoulders



Photograph by S. A. Grimes

EXTINCTION THREATENS THE EVERGLADE KITE

Some ornithologists believe there are not more than 30 individuals of this species left in Florida. Once it abounded in watery areas where it found large numbers of the fresh-water snail (*Pomacea*), its only food. Drainage and other encroachments of man have seriously restricted its range (page 134).



Photograph by George Shiras, 3d

FAVORITE PERCHES FOR CORMORANTS ARE CANAL MARKERS

One sits on the post as if to referee the race. Florida cormorants in large flocks frequent bays and lagoons along both coasts of the State, as well as the larger rivers and lakes. In pursuit of fish, they dive expertly and can remain under water for long periods, swimming rapidly.



Photograph by Luis Marden

A WARDEN'S HORSE RIDES TO WORK

Audubon Warden Marvin Chandler, who keeps a check on the avian population of a wide area in central Florida, uses a trailer to carry his horse as far as an automobile can travel. Then he mounts it and continues his patrol (page 117).



Photograph from W. M. Burdine

DEEP IN THE FOREST, THE SEMINOLE DEER HUNTER SETS UP CAMP

Gun in hand and dog at heel, the tribesman returns from the hunt with a deer slung over his back. Skins of other prizes dry on a pole. The Seminoles have built palm-thatched villages along the Tamiami Trail. The Indians are permitted to kill game on their reservations (page 141).

Occasionally a white pelican came sailing along, gliding low over the water like a fat-bodied amphibian airplane.

After several hours of watching the shifting panorama of bird life, Chandler steered the boat toward the mouth of the Indian Prairie Canal.

Overgrown with water plants, the mouth of the canal, the shallow bay there, and the marshes reaching out on either side, all combine to form an ideal feeding ground for birds. They kept us busy with the binoculars, Mr. Sprunt and the warden calling out the name of each additional species sighted.

High overhead, seven white pelicans soared in formation. Standing on a pile of coral rock thrown up in the digging of the canal were Caspian terns, laughing gulls, and herring gulls. Ducks of various species fed on aquatic vegetation. Flocks of white and glossy ibises rose from the marsh. Black-necked stilts waded daintily in the shallows. A bald eagle flapped in the distance and from a thick stand of reeds beside the mouth of the canal some 200 red-winged blackbirds kept up a ceaseless chorus.

It seemed that Chandler was poling the boat into a strange world, the only inhabitants of which were birds. Each few feet the boat moved brought additional species



Photograph by S. A. Grimes

A ROSEATE SPOONBILL PERFORMS A BALANCING ACT

Head down and wings upraised, it steps gingerly along a shaky branch on an island in Alligator Lake, on Cape Sable. This striking adult spoonbill has a yellowish-green head, white neck, back, and breast, and rose-pink body and wings. Its tail coverts and shoulders are splotted with carmine. Among the Ten Thousand Islands the author saw two flocks totaling 50 individuals, estimated as half the remaining spoonbill population in Florida (page 142).

into view. In not more than 20 minutes, 34 species were seen. Permitting the boat to float motionless, we sat watching the teeming bird life about us. Never had I seen so many species of wild birds in one spot.

ONE OF 30 EVERGLADE KITES

But there was to be a spectacular climax even to this impressive assemblage. The warden was poling the boat back out of the shallow bay when Mr. Sprunt half rose to his feet, rocking the craft and staring toward the mouth of the canal.



AP Photograph from Pictures, Inc.

IN SKILLFULLY FASHIONED DUGOUT, A SEMINOLE POLES HIS WIFE, CHILD, AND HOUSEHOLD GOODS TO A NEW HOME

In sharp contrast to the well-made boat is the crudely rigged sail. With the Indian's love of color, the tribesman wears a brightly figured shirt. About 650 Seminoles In hiding and made in hide and conveniences along the few roads which skirt their accessible haunts.



Photograph by Aero-Graphic Corporation

BOLDLY SWEEPING OVER THE WAVES, THE OVERSEAS HIGHWAY IS A CONCRETE THREAD STRUNG WITH BEADLIKE ISLES

A ramp leads down to buildings on palm-studded Pigeon Key, which gives a dry-land foothold to the viaduct. The tiny black specks beyond the drawbridge are automobiles. Protective railings edge the paving, which links Key West with mainland Florida.

"Just look over there," he called out excitedly.

Flying low over the water was an Everglade kite, one of the rarest birds in the United States (page 129). We watched as the bird, hawklike in appearance, flew to the shallows. Descending, it lowered its feet into the water, flapped hurriedly, and rose again with a large snail held in its claws. Flying to a small stump on the shore, it proceeded to make a meal of its catch. We sat perfectly still, watching the bird as it finished its repast, rose into the air again, and disappeared over the marsh.

This graceful bird was once common in Florida. Its diet consists mainly of the large fresh-water snail (*Pomacea*). Drainage and the inroads of agriculture reduced the areas where the snails were to be found, and the Everglade kite dwindled in numbers accordingly. Only eight nesting pairs have been located in the vicinity of Lake Okeechobee and some ornithologists believe there are not more than 30 of the birds left in the entire State.*

MARSH LANDS ARE ROOKERY SITES

Discussing our good fortune at having seen such a rare species, we moved through the calm water and pointed the boat back toward our starting place.

Taking leave of Warden Chandler, I

* A list of the birds seen in that one spot at the mouth of the Indian Prairie Canal follows: Everglade kite (*Rostrhamus sociabilis plumbeus*), turkey vulture (*Cathartes aura septentrionalis*), white pelican (*Pelecanus erythrorhynchos*), baldpate (*Mareca americana*), blue-winged teal (*Querquedula discors*), coot (*Fulica americana americana*), greater yellow-legs (*Totanus melanoleucus*), Caspian tern (*Hydroprogne caspia imperator*), laughing gull (*Larus atricilla*), herring gull (*Larus argentatus smithsonianus*), dowitcher (*Limnodromus griseus*), red-winged blackbird (*Agelaius phoeniceus*), yellow-throat (*Geothlypis trichas*), Louisiana heron (*Hydranassa tricolor ruficollis*), little blue heron (*Florida caerulea caerulea*), American egret (*Casmerodius albus egretta*), snowy egret (*Egretta thula thula*), white ibis (*Guara alba*), eastern glossy ibis (*Plegadis falcinellus falcinellus*), Florida cormorant (*Phalacrocorax auritus floridanus*), limpkin (*Aramus pictus pictus*), Ward's heron (*Ardea herodias wardi*), anhinga or water turkey (*Anhinga anhinga*), black-necked stilt (*Himantopus mexicanus*), southern bald eagle (*Haliaeetus leucocephalus leucocephalus*), palm warbler (*Dendroica palmarum*), shoveller duck (*Spatula clypeata*), boat-tailed grackle (*Cassidix mexicanus major*), ring-billed gull (*Larus delawarensis*), Forster's tern (*Sterna forsteri*), black skimmer (*Rynchops nigra nigra*), lesser scaup (*Nyroca affinis*), ring-necked duck (*Nyroca collaris*), duck hawk (*Falco peregrinus anatum*).

departed for an inspection of the great marshes of the upper St. Johns River. This stream is one of the broadest south-to-north-flowing rivers in the United States. Its upper reaches meander through a wide belt of marsh land which provides rookery sites for thousands of birds.

When we were there, the flocks were augmented by others which had migrated northward in search of places to establish nesting colonies. They had been driven out by the drought conditions which we were to find later to the south.

Host on this part of the trip was Warden Arthur Eifler. He and Mrs. Eifler live on an ancient Indian mound on the shores of Lake Washington, their house nestling in a grove of cabbage palms. The mound, called Cabbage Mound, is surrounded by swamp. While showing me about his home, the warden took a small stick and scratched in the earth of his doorway. After a few minutes he uncovered a fragment of Indian pottery. Evidently the mound contains many Indian relics, and Eifler would like to turn archeologist and excavate it, but he hates to dig his home out from under him.

The warden's job is to guard the Lake Washington rookery, one of the oldest and largest nesting places for water birds in the State. He promised us a sight we would not forget; that afternoon he kept his promise.

Leaving the dock in his motorboat, we cruised along the edge of the rookery. The birds could not have selected a better site to attend to their domestic duties. Stretching for a mile along the east shore of the lake, the rookery was a huge floating island.

Sweet myrtle, willows, cattails, saw grass, bulrushes, and other plants formed a tangle impenetrable to human beings. Any attempt a man might make to walk there would result in a disappearance through the heavy muck to the ooze beneath.

THE EGRET WITH THE LACY FEATHERS

Eifler anchored the boat out in the lake and we waited for the birds, which had been feeding as far away as 20 miles, to come home for the night. There was only a suggestion of a breeze and the boat floated on a glassy surface. From the rookery could be heard the gurgling call that the snowy egret makes during the mating season. Evidently they were the first occupants of the rookery to start nesting.

Like its larger cousin, the American egret,

the snowy egret was once on the verge of extermination by plume hunters (page 117). Federal laws were passed making even the possession of their lacy feathers a serious offense. The birds began to increase and continued until now they are again numbered in tens of thousands. Once more the American egret wanders as far north as New York State and even Canada in the summer, causing numerous inquiries and astonished reports from persons who have seen "a big, snow-white crane."

As if moving in accordance with some avian timetable, flocks of little blue herons and Louisiana herons appeared from the westward, flying low over the lake to the rookery. White ibises, large birds with curved pink bills

and white plumage except for black wing-tips, began to arrive at 6:10 p. m. During the next hour, as we sat there in the boat, approximately 45,000 birds flew to the rookery; 35,000 of them were white ibises.

They crossed above the lake in long files, the birds following a leader and keeping themselves evenly spaced in line. Some of the files contained several hundred ibises. In general they kept pace with each other, all the birds in line flapping and gliding in unison. In some of the shorter files the timing was so perfect that it seemed as if some invisible coxswain were call-

ing out the beats for his feathered crew.

Most spectacular was the manner in which the lines of birds rose and dipped as they crossed the lake. So closely did they follow their leaders that they seemed to be moving over unseen hills and valleys rather than traveling in mid-air.

As more and more birds arrived, the chorus from the rookery rose to a raucous din. It subsided again as the great bird city settled down for the night. As in the case of the Florida cranes, it was almost dark when the last files winged their way across the lake.



Photograph by Luis Marden

"OKAY, YOUNG FELLOWS, THAT'S ALL TODAY!"

An Audubon warden has stopped two boys on their homeward way from a rural school near Lakeport on Lake Okeechobee to question them about a poacher seen in the vicinity. Residents of the area give much help to the officers in tracking down law-breaking hunters, and inform them about the movements of birds and animals.



Photograph by Ernest G. Holt

READY TO JUMP AT THE DROP OF A HAT

A wary young Florida crane "faces off" with Audubon Warden Marvin Chandler on the Kissimmee Prairie, one of the bird's principal breeding grounds. A close relative of the sandhill crane, this species is now comparatively scarce. Only about 3,000 of them are left (page 126).

The warden made careful estimates as the birds came in.*

From Lake Washington I made a quick drive to Miami, jumping-off place for the next part of the trip (page 123). Arriving in the morning, we found the city enveloped in a thick pall of smoke. There had been a prolonged drought and large areas of the Everglades were on fire. A wind from the west was bringing the smoke for miles, carrying it into east-coast cities and on out to sea.

Waiting until a shift in the wind had driven back the smoke and increased visibility, we took off in a U. S. Coast Guard seaplane with Commander C. C. von Paulsen at the controls. Before flying over the Everglades, the plane followed the Florida Keys, that long chain of low is-

lands which curves from the southeastern tip of the Florida Peninsula far into the Gulf of Mexico.

THE STAY-NEAR-HOME BIRD

The Florida Keys constitute the home of the great white heron (*Ardea occidentalis*), grandest of American herons and a bird which probably has a smaller range than any species in the United States. Four years ago there were only about 160 of these spectacular birds left alive.

After several years of protection by Audubon wardens a census last spring showed they had increased to about 600 individuals. In October, 1938, President Roosevelt issued an executive order creating the Federal Great White Heron Refuge on the western end of the Florida Keys. Since then, Audubon wardens and wardens of the United States Biological Survey have co-operated in protecting them.

Beneath us the keys extended like irregular beads held together by the recently built Overseas Highway running all the way to Key West (page 133). It was hard to believe that the water about them could be so many shades of blue and green. For long stretches it was clear and shallow, every

* A compilation of the populations of the Lake Washington rookery follows: white ibis, 35,000; Louisiana heron, 3,000; little blue heron, 3,500; glossy ibis, 150; snowy egret, 2,000; American egret, 300; Ward's heron, 24; anhinga, 100; Florida cormorant, 50; Florida duck (*Anas fulvigula fulvigula*), 8; Florida gallinule (*Gallinula chloropus cachinnans*), 24; purple gallinule (*Poronotis martinica*), 8; black-crowned night heron (*Nycticorax nycticorax hoactli*), 75; yellow-crowned night heron (*Nyctanassa violacea violacea*), 25.



Photograph by Allan D. Cruickshank

A BLACK-TIPPED WHITE IBIS GIVES A LESSON IN SOARING

Legs stiffly trailing and neck outthrust, the bird glides across the sky. In a single hour the author watched 35,000 ibises fly in long files across Lake Washington, on the upper St. Johns River, to their rookery (pages 134-5).

detail of the bottom visible as we passed over it. The sand showed gray or brown, shelving off to the white of the beaches surrounding the islets. As the water deepened, it graduated to darker shades of blue. Here and there were inky patches marking spots of considerable depth, surrounded by belts of aquamarine.

AN OSTRICH OF SALT WATER

A Florida cormorant floating on the surface appeared as if suspended in mid-air (page 129). Frightened by the roar of the plane, it turned its head to look at us and then dived beneath the surface. It seemed a foolish way to escape, for we could see the bird under water almost as clearly as when it was on top. Looking back, I watched it come up again amid a ring of ripples, evidently satisfied that it had played a neat trick on the noisy monster above.

Large sharks moved along the bottom, singly and in groups. At one point, seven of them swam in a school. A few miles farther, the occupants of a pleasure cruiser turned their faces skyward to watch the passing of the plane. They did not know that while they watched us a pair of sharks

of no mean size swam almost underneath their boat.

Besides sharks, we saw an occasional sea turtle basking at the surface and giant rays stirred up clouds of marl as they flapped their "wings" against the bottom.

As the plane zigzagged over the low islands, Commander von Paulsen and I counted the great white herons on each key. The white bodies stood out unmistakably against the foliage. After counting the birds on one half of an island, the commander would swing the plane around sharply to the other side.

A BIRD CENSUS BY SEAPLANE

Passing over the city of Key West, the plane continued to the Marquesas Keys, 20 miles beyond (map, page 118). Here was a coral atoll, a circle of coral islets enclosing a wide lagoon. The plane swung around so the herons could be counted and then the commander set a course direct for Cape Sable.

For a time no land was visible. Then, directly ahead of us, we saw the low-lying coastline of the cape, appearing as it did when Ponce de León approached it on his historic search, a long line of green formed



Photograph by George Shiras, 3d

WATCHFUL EYE AND SPINE-RIBBED BACK REVEAL A BASKING ALLIGATOR

In dry seasons in the Everglades, gators seek out pools and marshy hollows. They excavate tunnels, or enlarge natural caves, to a length of as much as 15 or 20 feet, and in the underground dens they "hole up" for considerable periods. Alligator hunters, mostly Indians, are said to draw the big reptiles out of their pits by grunting in such a way that the creatures come to the surface to exchange greetings. Rods also are used to poke them from their lairs (page 141).

by the trees and beneath it the white sand of the beach.

Nearer at hand a tangle of dead trees, uprooted and tossed about by the hurricane of 1935, formed an impenetrable jungle. Behind the cape was Whitewater Bay with its many mangrove islands. On our left was Ponce de Leon Bay. The plane headed toward it and then swung inland to follow the winding course of the Shark River, a stream which forms in the Everglades and flows southwest through forest which has never heard the whine of the sawmill.

When the river had become a mere twisting creek, Commander von Paulsen touched my shoulder and indicated the view ahead with a wide sweep of his arm. Before us lay the Everglades, one of the strangest of American landscapes.

Flat as a table and seemingly endless, the sun-baked land spread out beneath us. It was like a greenish-brown carpet, pockmarked with blackish holes, dry beds of

shallow ponds. Normally, the Everglades would have been covered with several inches of water and the ponds would have been full, but the prolonged drought had left them sere and lifeless (pages 124-5).

Thousands of water birds had deserted the region for the well-watered country to the north. I had seen some of those wandering flocks at Lake Okeechobee and the marshes of the St. Johns River. Now the Everglades were waiting for the summer rainy season to bring them verdure and the returning wild life.

A MILLION-ACRE FIRE

The commander pointed to the north. Ahead rose towering columns of smoke. Bright fingers of flame which had been creeping across the Everglades for weeks slowly ate their way through the dry saw grass and palmetto. These were the fires which had been sending their smoke clouds eastward to harass the cities along the coast.



Photograph by Luis Marden

WHEN THE CALF GETS UP HE'LL HAVE A "TRADE-MARK"

Cowboys brand cattle with an identifying mark on a south Florida ranch. Branding is usually done at weaning time, when the animals are eight or nine months old. The Kissimmee Prairie, north of Lake Okeechobee, is an important cattle-raising area (page 120).

Gaining altitude, the plane passed through the wall of smoke and flew over a scene of utter devastation. The burning and blackened land stretched away as far as the eye could see in any direction. Here and there small geysers of smoke marked spots where pockets of the dried peatlike soil continued to smolder after the flames had passed on. The only living things visible were turkey vultures wheeling low over the blackened ground in search of the carcasses of animals which had been trapped by the fires.

For the remainder of the flight the commander cruised a wandering course so the area swept by the fires could be traced on the map. Later a conservative estimate showed that more than a million acres of the Everglades had been burned over.

Not until we were within a few miles of Miami did the fires come to an end. As we passed over the last of them, farmers were plowing firebreaks to protect their crops.

Next morning I left Miami again by automobile, this time to see the Everglades and

the Big Cypress country from the ground.

My companion on this part of the trip was Warden Ray Barnes, who knows the swamps, the prairies, and the rivers as well as a Seminole.

Rolling along the Tamiami Trail, we again passed through the burning area. Smoke clouds grew so thick over the trail that motorists were prevented from taking that route for a time, lest, blinded by the smoke, they run their cars into the canal which parallels the highway.

After mile upon mile of prairie, the Everglades finally merged into the Big Cypress Swamp. The eastern part of it is a belt of scrub cypress 18 to 20 miles wide. Farther west lie the great, untouched swamps with their virgin forests of giant cypress, black-jack oak, maple, and various species of palms. In one section we found royal palms towering 110 feet in the air.

During the day we passed through part of the proposed Everglades National Park, a large area extending from north of the



Photograph by Eric Fleet

A FIRM GRIP, A TOSS OF THE HEAD—AND THE FISH IS STOWED

The brown pelican nets its food in the capacious pouch under the bill. Fish are stored in the stomach.

Tamiami Trail all the way to Cape Sable. Some day Florida's visitors may drive through this subtropic land or take regular boat trips up the coastal rivers.

That afternoon we were joined by another companion and changed vehicles for a trip into the swamp country. The new member of the expedition was Wilson Dykes, State Game Warden, and the new vehicle was a "Glades buggy."

A "MOTORIZED BULLFROG"

The Glades buggy is a sort of motorized bullfrog, an adaptation of the machine age to the jungle (page 141).

A favorite way of making a Glades buggy is to select a light automobile, tear out the rear end, and replace it with that of a truck. Four or even six wheels are attached to the rear axle for traction over the soft ground. Sometimes the tires are inflated, but often they are left flat and held on with heavy chains.

The vehicle is stripped to the essentials. Traveling in one is like riding on a pump handle. It makes three to five miles an hour when the going is rough, and as it bumps over logs, cypress knees, and gullies, its movements in a vertical plane exceed its forward progress.

As our Glades buggy pursued its ago-

nizing course, I recalled with pleasure the rides on the Kissimmee Prairie. In comparison they seemed like trips on an express highway.

Our first destination was the Fakahatchee Swamp, largest of the swamps in the Big Cypress area. It is 22 miles long and three to five miles wide. On either side of it, fingers of smaller cypress trees extend out from the main body of the swamp. Between these fingers, or sloughs, are islands where tall slash pines mingle with cabbage palms, or small prairies where the grass grows waist-high. One of them was circular, and Barnes called it "Dollar Prairie."

A few hundred feet from the Tamiami Trail all signs of civilization disappeared. As our buggy bumped along, an occasional raccoon dashed for cover or deer which had been feeding in the open bounded into the woods. Several times we stopped and, with Barnes in the lead, sneaked through the grass to see wild turkeys. Once Barnes led us close without disturbing the birds and we watched a big gobbler strut and vocalize for the admiration of two hens.

The Big Cypress is one of the few places left where the true wild turkeys still exist. In most sections tame turkeys have escaped from farms and crossed with the wild stock.

That night our camp was made on a pine



Photograph by Luis Marden

"THE GLADES BUGGY IS A SORT OF MOTORIZED BULLFROG"

Wilson Dykes, State Game Warden, demonstrates the toughness of his remodeled automobile. The carburetor is on top of the motor, permitting the engine to run even when the vehicle is almost submerged. Four rear wheels equipped with heavy chains give traction on slippery ground (page 140).

island deep in the swamp. After dinner, as we sat around a campfire, a pair of barred owls perched in the trees over our heads. For almost an hour they hooted, clucked, snapped their beaks, and otherwise demonstrated their disapproval of the invaders. They were still keeping up a lively comment when we crawled into our sleeping bags.

After Barnes had demonstrated his uncanny ability at waking up at the first pale glint of dawn, we had breakfast and set out into the swamp on foot. In a mile and a half of walking, we saw eleven deer. We also came upon a spot where the bleached bones of deer were strewn on the ground, marking an old camp of meat hunters.

These poachers kill the deer and strip the flesh from the bones. Then they carry the meat through the swamp on their backs to the Tamiami Trail, where it is transferred to automobiles. The meat from one deer brings about \$12. Warden Dykes sometimes spends weeks on the trail of meat hunters before apprehending them in their hideouts in the swamp.

Back in camp, we again boarded the Glades buggy to follow a faint trail which Barnes called a road. We made numerous stops. One was at a "cypress head," a large

clump of cypress trees and other vegetation marking a low spot away from the sloughs and runs of the main swamp. Pushing our way through the tall grass to the center of it, we came upon an alligator cave.

In the dry season large alligators seek out low places where they dig caves in the soft earth to get down to the water level. These caves form small pools which become congregating places for many animals.

THE GRUNT THAT FAILED

Alligator hunters have several methods of getting the gators out of their caves. One is to "grunt 'em up." The hunter sits near the mouth of the cave and grunts in a manner calculated to be appealing to the alligator. It is asserted that the alligator, hearing the grunts, will come to the surface of his pool to exchange grunted greetings. When he does so he is shot. If this method fails, iron rods are used to poke and drag the reptile from its aquatic lair (p. 138).

About the pool formed by the cave were the tracks of wildcats, raccoons, otter, and other animals. The thick vegetation surrounding it included custard apple, maple, willow, and cypress. Wild orchids hung on the mossy limbs of the trees.

The three of us sat on a log, remaining quiet in hopes that the alligator would come to the surface. Even I tried grunting a few times. Barnes studied the muddy ground about the pool and assured us that the resident of the cave was still inside. The alligator failed to accord us any recognition, but, as we sat on our log, cottonmouth water moccasins came crawling to the pool from several directions. One of them passed within a few feet of my legs.

"Just sit still and they won't bother you," whispered Barnes. I might as well have been a statue.

From the Fakahatchee Swamp we journeyed northward to the Corkscrew Swamp, which lies to the south of Lake Trafford. This swamp is the site of an ancient rookery which contained 30,000 nesting wood ibises (*Mycteria americana*). The wood ibis, the only true stork inhabiting the United States, is a tall, solemn bird with a bare, wrinkled head and a huge beak. Lacking fancy plumes and not being palatable, it is one of few Florida birds which have been unmolested (page 128).

Crawling over fallen logs and cypress knees, we made our way on foot to the slough along which the birds were nesting. For almost a mile along its shore the cypress trees were decorated with the nests. We counted 16 nests in a single large tree. The young birds stood on the twiggy structures with comical solemnity, waiting for their parents to bring them food.

For a while we sat on a big log at the edge of an oval lagoon. Bird life was abundant in this unspoiled setting. About the lagoon the straight shafts of the cypress trees rose sheer to the leafy tops where the wood ibises stood on their nests.

Moss hung in streamers from the limbs and on the water floated the green rosettes of water lettuce. A snakebird perched on a stump, holding out its wings to dry. An American egret stood in the shallow water. Little blue herons sailed over the lagoon and young wood ibises which had left their nests made awkward attempts to support themselves on the floating vegetation.

A SCORPION GOES TO THE FAIR

For four days we wandered through the swamp country and at last emerged again onto the Tamiami Trail. A brief side trip was made to Marco Island where I captured a whip-tailed scorpion which I had promised to get for Dr. Raymond L. Ditmars, of the New York Zoological Park, who

wanted it for his exhibit at the New York World's Fair.

Barnes had saved one of the most beautiful sights in all Florida wild life for the last. In a small motorboat we cruised down among the Ten Thousand Islands on the chance of seeing a flock of roseate spoonbills (*Ajaia ajaja*). Repeated counts by Audubon wardens had failed to show that there were more than 100 of these large pink birds with the paddle-shaped bills left in Florida (page 131). After the nesting season the spoonbills spread out in flocks to feed among the hundreds of mangrove islands along the southwest coast. There we hoped to find them.

As the boat wound among the myriad islands with their tangles of mangrove roots, an occasional brown pelican dived for fish. An osprey circled overhead and various species of herons perched along the shore. In a shallow cove Barnes suddenly pointed, shouting, "Look! There they are!"

A RAINBOW OF BIRDS

From behind a dense mangrove thicket a flock of thirty roseate spoonbills rose with rapid flapping and began to circle over the boat. Their bodies were rich pink and on each wing was a bar of deeper pink, almost carmine. As they circled, their plumage stood out in sharp contrast against the deep blue sky and the fleecy white clouds.

They rose higher and higher, as if climbing a winding stair. A second flock rose to join them in the air, making about fifty birds. They represented half of the roseate spoonbills believed to be alive in Florida today. Stretched out on my back in the bottom of the boat, I watched them until they became mere dots of pink wheeling against the blue. Slowly Barnes began poling the boat back to deeper water. As he did, the birds descended their stairway from the sky to drop once more into their feeding grounds among the mangroves.

The next morning Barnes helped me pack for the journey back north. He laughed as we stowed away my souvenirs of the trip. They included some wild orchid plants we had collected in the swamp, a set of deer antlers we had found at the camp of the meat hunters, some wild oranges, and the whip-tailed scorpion. But the greatest souvenir of my visit was a lasting impression of the wilderness area of south Florida, a region which has no counterpart anywhere in the United States.

WHO TREADS OUR TRAILS?

A Camera Trapper Describes His Experiences on an Island in the Canal Zone, a Natural-History Laboratory in the American Tropics

BY FRANK M. CHAPMAN

Curator of Birds, American Museum of Natural History

AUTHOR OF "OVER THE ANDES TO BOGOTÁ," "A NATURALIST'S JOURNEY AROUND VERA CRUZ AND TAMPICO,"
ETC., IN THE NATIONAL GEOGRAPHIC MAGAZINE

With Illustrations from Photographs by the Author

IF THERE be any sport in which the joys of anticipation are more prolonged, the pleasures of realization more enduring, than that of camera trapping in the Tropics I have yet to find it! From the moment when, after consideration of all the possibilities, you select a place in which to set your trap until the developments of the dark room show you what you have, or have not, captured, imagination keeps pace with expectation.

The result is often complete disappointment. But it may bring such elation that, so narrow is the boundary line between the manifestations of uncontrolled enthusiasm and dementia, it is safe to give full expression to your feelings only when you are alone!

It is well, also, to temper your exultation when in the presence of a big-game hunter. He tells of hardship in the pursuit of his prey and of more or less risk to life and limb in the killing of it. But I am usually asleep when my game is "bagged" and desire to kill nothing. Yet, so far as personal danger is concerned, I expect to blow my head off every time I set a camera. Furthermore, the rifle bearer may be reminded that, armed only with a field glass, I invade the haunts of large predatory mammals which are so aggressive that on Barro Colorado Island we have yet to see them!

BARRO COLORADO ISLAND IS A NATURAL TROPICAL LABORATORY

But whatever the decision as to ways and means, final judgment in the case of camera *v.* rifle will be based on results. So herewith I submit my winter's bag, together with a brief description of the

place in which it was made, certain details in regard to the manner in which it was secured, and such further comments as seem desirable.

Barro Colorado is an island of about six square miles in area in the Canal Zone. With many others it was created by the closing of Gatun Dam and the subsequent overflow of 165 square miles of lowlands. Its summit is 537 feet above the sea, 452 feet above the lake. With the exception of a few acres, it is densely forested. Thanks to the enthusiasm and foresightedness of a number of naturalists and the support of a sympathetic administration, it has been set aside by our Government as a sanctuary for the conservation and study of tropical life.

The fact that the Canal Zone is the only bit of continental Tropics under our flag, and that Barro Colorado is the largest as well as the most nearly primitive island in the Zone, show clearly that it is an area of exceptional value.

The preservation and use of this natural laboratory have been entrusted to the Institute for Research in Tropical America. This organization, which is supported by small annual payments from several colleges and museums, students' fees and private contributions, has erected several buildings which afford naturalists comfortable living quarters and facilities for the pursuit of their investigations.

Its first aim is the preservation of natural conditions. The ground has been cleared only around the laboratory. About ten miles of trails have been cut, but without the loss of a single large tree. One may examine the accompanying airplane photographs, which clearly show the roof



Drawn by James M. Darley

BARRO COLORADO IS THE LARGEST ISLAND IN THE CANAL ZONE (SEE PAGE 331)

of the forest, without detecting any evidence of the paths that permit of easy and noiseless passage through the dense growth below (see illustrations, pages 334 and 335).

These trails have not brought with them the devastation that usually follows the path of man. The neighboring mainland contains far wilder-looking ways, but they have been traveled for centuries. Animals large enough to rank as game have long since disappeared from or become rare near them. But our trails were made for purposes of observation, not destruction, and it is improbable that they have in any way interfered with the natural life of the island. On the other hand, they have greatly facilitated the observation of it (see page 336).

Who treads these trails with us? The sudden rush through the undergrowth or the half-seen figures may be only coats; the startling call of alarm may be only an agouti's, but it is the thought of the potential jaguar or puma which springs to mind when one hears these smaller

animals. In spite of their assumed presence, these, and some other large mammals, have never been definitely recorded from the island.

How could we establish the fact of their residence? We might use dogs and the methods of the chase; we might employ skilled trappers; we might even resort to poisoned bait. But the motto of Barro Colorado is "Live and let live." We want a census of the living, not a record of the dead. How then could we make it? The answer is, by that type of autophotography with which George Shiras, 3d,*

* See, also, the following articles, and others, by George Shiras, 3d, in the NATIONAL GEOGRAPHIC MAGAZINE: "Nature's Transformation at Panama: Remarkable Changes in Faunal and Physical Conditions in the Gatun Lake Region," August, 1915; "Photographing Wild Game with Flashlight and Camera," July, 1906; "Camps and Cruises of an Ornithologist," May, 1909; "Wild Animals That Took Their Own Pictures by Day and by Night," July, 1913; "The Wild Life of Lake Superior, Past and Present: The Habits of Deer, Moose, Wolves, Beavers, Muskrats, Trout, and Feathered Wood-Folk Studied with Camera and Flashlight," August, 1921; etc.



THIS IS THE "GUN" THAT "BAGGED" THE TROPHIES

The cups holding the magnesium powder, at each side of the camera, are connected by wires, and the trip-wire runs to a battery beneath the cup at the right (see text, page 337).



THE FLASH CAMERA IS NO RESPECTER OF PERSONS

In crossing the wire a visitor to the island focused his attention so intently upon his feet that he failed to raise his staff, which touched the wire and exploded the flash.



Official Photograph, U. S. Army Air Corps

BARRO COLORADO IS ONE OF THE MANY ISLANDS STUDDING GATUN LAKE

Seen from the air, one can best appreciate the primitive state in which Barro Colorado has remained. This island, in the foreground, has an area of about six square miles, and rises to an extreme height of 452 feet above the lake. As shown by the unbroken sea of tree tops, it is densely forested and has been set aside by the Government as a sanctuary wherein the wild life of tropical America may be conserved and studied (see text, page 331. and map, page 332). The arrow points to the laboratory.



Official Photograph, U. S. Army Air Corps

THE LABORATORY OF THE INSTITUTE FOR RESEARCH IN TROPICAL AMERICA AND ITS SURROUNDINGS FROM THE AIR

The cleared ground leading to the water is planted with bananas, yuccas, yams, and plantains. The dark patches extending upward from the landing place mark the course of a brook. Three trails penetrate the forest from the laboratory, but so carefully have they been made that their location is not apparent (see text, page 331).



AN OBSERVATION PERCH IN THE HEART OF THE FOREST

From such points of vantage many of the secrets of jungle life are revealed to the naturalist. Eighteen collared peccaries were seen here, feeding on fallen figs, and in the branches overhead six howling monkeys, four toucans, and five guans were gathering the fruit.



THIS SPINY RAT IS GETTING THE SCARE OF HIS LIFE

It is difficult to conceive a more terrifying experience for the timid and sensitive creatures of the woods than a sudden encounter in the night with the blinding glare of light and cannon-like report of the flash powder at a distance of only 10 or 11 feet. However, their fright seems to do them no permanent harm (see text, page 344).

has made us familiar and which William Nesbit has also developed. It was two of the latter's outfits which, in the margin of time left by my bird studies, I used upon the island.

Exclusive of bats, E. A. Goldman, in his "Mammals of Panama," records fifty-odd species of mammals from the Canal Zone. They range in size from mouse to tapir and include two species of peccaries, two of deer, the ocelot, puma and jaguar, and giant anteater, besides more easily observable arboreal forms such as monkeys, squirrels and sloths.

We do not know how many of these animals are found on Barro Colorado, nor have we exact information as to how the flooding of the lowlands affected the fauna of the island. As the waters slowly rose, many lines of retreat were open to the inhabitants of the submerged districts. Doubtless, therefore, they were widely distributed. But beyond question the protection afforded by insulation, and by the subsequent prohibition of hunting, has done much to maintain primitive conditions on the island and to give exceptional opportunity for study.

VARIOUS CONDITIONS DETERMINE LOCATION OF CAMERA "STAND"

To encourage the close approach of animals to the laboratory, the ground immediately surrounding our quarters has been declared *sanctum sanctorum* and flash-light photography is there prohibited. Beyond a distance of 300 yards, however, this restriction is removed and one is free to employ any fair means to capture the image of one's prey.

Now begins a still hunt for evidence that an animal has visited and will return to a given locality. During the dry season (December to April), when the ground is hard and usually leaf-covered, tracks are difficult to find. My limited experience has not revealed productive water holes.

One is therefore influenced in the selection of a camera "stand" by a variety of circumstances—the presence of fallen fruit, the density and character of the undergrowth. But in the belief, doubtless erroneous, that our trails look as attractive to animals as theirs do to us, I generally stretched the trip-wire across them. Fur-

thermore, pictures of animals following human footsteps possess greater interest than those which might be secured in parts of the forest which we rarely if ever visit (see page 333).

After the stand is selected, the trap is set. This is an interesting operation. One visualizes the possible subject, the direction from which it may come, and determines the distance and angle at which it should be photographed. A fine wire is then stretched from tree to tree across the assumed pathway of the prospective subject and, after being passed through a staple, is run parallel with the trail to the battery near the camera. Unless it be properly guarded, this side wire may be sprung by some animal crossing, instead of following, the trail.

Early in my experience with this kind of hunting, I had gone less than 200 feet from a camera after setting it when the charges exploded. The sound resembles the report of a small cannon. Smoke was still drifting through the trees when I reached the stand, but no sign of life was visible. The development of the plate, however, revealed the tip of the tail of a coati which had crossed the trail directly in front of the camera.

Two metal cups, each containing a box holding half an ounce of magnesium powder, are attached to trees slightly above and behind the camera. One of them is connected with the camera shutter so that the force of the recoil occasioned by the explosion exposes the plate at the moment of greatest illumination. A 6-inch lens is used wide open, and the shutter is set for an exposure of a two-hundredth part of a second.

BANANAS MAKE POPULAR BAIT

After the several wires are connected, the shutter arranged, and the slide drawn from the plate holder, it remains only to close the switch that sets the trap. Electrical devices in the hands of the uninitiated sometimes do inexplicable things. I never complete this connection without tense expectation of its attendant possibilities. Assuming that they do not materialize, one backs off carefully and, if one's way leads past the trip-wire, steps over it cautiously (see page 333).

The question of bait is important.

Food tied to the trip-wire may attract large game, but it is far more likely to bring the smaller rodents that throng the forest. With the hope, therefore, of securing animals too large to pass beneath the wire, no bait is employed during the first three or four nights at a new stand. Or the trail may be dragged with meat, fish or fruit. If these fail to yield results, a ripe banana tied to the trip-wire was found to make a more universal appeal than any other food.

After these details are attended to, you return to camp. Possibly during the night you hear the booming report of an explosion, and visualize the eye of the camera opening and closing to record on the "retina" of the sensitive plate a potential image of whatever "fired the flash." In North America, where the fauna is well known, one may usually surmise whether he has caught large game or small. But there is no census of the animals of Barro Colorado and the possibilities include most of the terrestrial Mammalia of the American Tropics.

The magnesium powder is packed in red boxes, the tops of which may be seen from some distance in the shallow metal cups from which they are exploded. Inserted with full faith in their potency, these neat little disks spell failure if you find them still on guard when you return. But if in their place there is a scorched box bottom and a burnt-out fuse, anticipations which were born when the stand was selected acquire new strength.

What manner of beast sprung the trap? The trip-wire and its surroundings are examined for clues. The extent to which it is stretched gives an indication of the strength of the animal that sprung it; the direction in which it is stretched tells from which side the creature came. If the wire is broken imagination, given the rein, runs wild among the larger possibilities.

THE NATURALIST JOYS IN HIS PHOTOGRAPHIC "BAG"

At times a footprint is visible, deepened perhaps by the spring of the startled animal which, in the stillness of the night and security of its haunts, suddenly comes into close quarters with thunder and lightning.

Between failure and success interpose also the countless mishaps of photog-

raphy. These are increased in the Tropics where in a moment a perfect negative may become merely a piece of glass or an entire landscape be devoured by a cockroach.

To avoid unnecessary handling, plates are developed by time, a desirable method in any event where the intensity of the light and length of exposure are always the same. The climax of the whole procedure is not reached, therefore, until the plate comes from the hypo clearing solution and the alchemy of the dark room adds to the magic of the camera trap.

THE CAMERA RECORDS SHY ANIMALS

Besides agoutis, coatis and other small game, imagine the satisfaction with which I beheld the images of two white-lipped peccaries, the joy occasioned by the figure of a stalking puma, or the supreme exultation with which I discovered that I had actually photographed a tapir in the surprising act of eating a banana! (See illustration, page 339.)

It was soon after developing this plate that I wrote the opening paragraphs of this article. Not one of these animals had been seen on the island, and, other considerations aside, the pleasures of life on Barro Colorado were materially increased by the knowledge that I had such distinguished neighbors.

At the beginning of my venture in this, to me, new field, I found that the photographic bag of one visit to the dark room held two ocelots and a puma. At that rate I saw myself the early possessor of a unique gallery of portraits of tropical American mammals. But the succeeding three months failed to bring another ocelot and it was two weeks before the traps were sprung again.

Then ensued a series of mishaps. The charges were fired as though by an unseen hand, for the developed plate revealed no sign of life. Once the trip-wire was actually untied from its fastening without the flash being fired. Later I learned that heavy leaves falling on the wire, or the swaying of trees to which it was attached, may cause premature discharge of the magnesium. Yet the method by which the wire was detached without the electrical connection being completed remained a mystery. It was through no fault of the camera which, after three



SAVAGE MEMBERS OF THE SWINE FAMILY

These white-lipped peccaries stand about 16 inches high. They are peculiar to the Western Hemisphere, and inhabit South and Central America from Paraguay to British Honduras. They travel in herds of large size, and when angered will attack anything, including human beings.



A BANANA TEMPTED THIS TAPIR

Inoffensive and shy at most times, but capable of fierce resistance on occasion, the tapir is one of the oldest and least changed of animals. Fossils of specimens that lived in a remote period are nearly identical with tapirs of to-day.



THE PUMA USUALLY TAKES WELL TO CAPTIVITY

A legend persists among the Indians and Gauchos of South America that the puma is the one wild member of the cat family that is naturally friendly to man.



THIS CAT SHARES WITH THE JAGUAR THE LORDSHIP OF THE AMERICAN JUNGLE

The puma is the only beast in the Central and South American jungles powerful enough to dispute the dread jaguar, which it excels in agility.



IN MANY RESPECTS THE PUMA IS AN OVERGROWN KITTEN

Pumas will frolic together or alone, fight sham battles, chase butterflies, or play hide and seek. This animal is not fully grown (see text, page 342).



A SLEEK AND CUNNING BEAST OF PREY

Ears back, head down, and nose to the ground, this lithe-limbed puma is the embodiment of stealth and strength. He is the largest of the pumas photographed.

months of exposure to humid, tropical weather, remained in excellent condition.

It will be a long time before the possibilities of Barro Colorado's fauna are exhausted, before a jaguar and giant anteater have automatically registered themselves as present there. It will be longer still before one ceases to be thrilled by the capture of the portraits of animals so shy and retiring or so exclusively nocturnal that we rarely if ever see them.

There is endless interest in recording new phases and expressions of even the commonest animals. Bananas rarely failed to attract the raccoonlike coatis, probably the most common of the larger animals on the island. They showed surprising skill in removing the bait without firing the flash, and, in spite of their numbers, it was difficult to secure satisfactory pictures of them (see pages 343 and 344).

The peccary, with its head pressed against the trip-wire, seems to have paused at the command of the photographer; only its upraised foot shows that it was in motion (see illustration, page 339).

THE FLASH LIGHT SURPRISES THE UNSEEN PUMA

The animal crowding in at the side illustrates the manner in which these creatures travel in close-massed groups. Doubtless there was a sudden breaking of ranks at the glare and report that followed the tautening of the wire. Nevertheless, within two days a band of peccaries, perhaps the same one, passed this way. The next night the charges were fired at 2 a. m. by an ocelot, indicating that these cats are not only crepuscular but truly nocturnal.

The camera's most surprising revelation was proof that pumas, as yet unseen by us, are common inhabitants of the island. All my pictures of this animal were secured within a radius of half a mile, and most of them represent not only different individuals but different moods of the species.

One puma (see illustration, lower, page 341) is the typical beast of prey, slinking along with head down and ears back; a vicious-looking, well-fed animal, evidently at the maximum of his powers.

He is, I think, the largest of the pumas photographed. Approaching night caused me to set hurriedly the trap he entered.

The lateral wire leading to the battery was not well protected. The following day it was found widely sagging and the charges exploded—evidence that an animal had entered from the side.

Development of the plate apparently confirmed this diagnosis by recording what appeared to be a portion of an agouti much out of focus. At the same time, I developed a plate showing leaf-cutting ants (see, also, page 344). Having accounted for the flash light I held this second plate to the light, with the image of ants in my mind's eye, only to discover the figure of a superb puma. My diagnosis had been wholly wrong, and transposition of the two plates in the developing tray had led me still further astray.

The surprise occasioned by the transformation of a mental ant into an actual puma was exceeded in the winter's experience only by the discovery that a supposed coati was in truth a tapir, the largest and one of the most elusive animals of the region.

The pumas shown at the top of pages 340 and 341 were photographed at an interval of three months and at stations a mile apart; nevertheless, I believe them to be the same animal. The figures agree in size, proportions and markings. Since the camera in all these pictures was set at the same distance, 11½ feet, from the wire, objects there are always comparable as to size.

Observe, therefore, the agreement in dimensions of the foreleg in these figures. Incidentally, in one photograph (page 341) the trip-wire is broken; in the other it has been cleanly stepped over with the right forefoot and was evidently sprung at the succeeding step.

THE OCELOT INTENTIONALLY CLEARS THE TRIP-WIRE

With the ocelot (p. 330) essentially the same fact is shown, but here the left forefoot was the first one over. It is a question whether these animals stepped over the wire unconsciously or whether they sensed it, even in the dark, and intentionally cleared it with the first foot. Steps 9 or 10 inches high (the distance of the wire from the ground) would imply needless exertion where the trail was open.



THE AGOUTI IS AMONG THE SHIEST OF FOREST CREATURES

The agouti, a cousin of the guinea pig, is common in Central and South America. It is swift in its movements. Its fur is long and thick, and usually chestnut or olive in color.



RACCOONLIKE COATIS ARE NUMEROUS ON BARRO COLORADO ISLAND

Possessing habits of the raccoon and the squirrel, the coati is an arboreal little animal, living principally on birds, mice, worms and insects. Although playful, he is not a pleasant-looking creature because of his long, piglike snout (see, also, text, page 342).



ENJOYING A BANANA AS THE PRICE OF HIS PICTURE

The coati succumbed to the lure of a ripe banana, thereby bringing on himself the lightning and thunder of the flash powder. The large, round object is the nest of termites, or so-called "white ants," that was tied to the wire in the hope that it might attract an anteater.

Obviously the second step is not that high. It would appear, therefore, that these cats, even in the dead of night (the ocelot picture was made at 2 a. m.) are aware of the presence of the wire and make a partial attempt to step over it.

The flash of the peccary, on the contrary, shows that the animal made no attempt whatever to avoid the wire into which its muzzle is pressed (see, also, text, page 342).

Returning to the comparison of the pumas shown on pages 340 and 341, it will be seen that not only are they marked alike—observe especially the light specks above the shoulders—but that they wear much the same expression. Assuming, therefore, that this is but one individual, the two pictures admirably illustrate one of the most distinctive features of camera-hunting, namely, that we may capture the same animal an indefinite number of times and still leave him as free as he was in the beginning.

In this particular instance, it is not only especially reassuring to believe that the two pictures are of the same individual,

but also that the earlier experience has left no visible result on his expression. It is true that in one picture he apparently stepped on the wire, while in the other he stepped over it; but aside from this difference he seems to tread the trail with confidence.

PHOTOGRAPHING AN ANIMAL'S FEAR REACTION IS UNSPORTSMANLIKE

I do not believe that we can realize what a shock it must be to these timid, exceedingly sensitive creatures to be flash-lighted. It is difficult to conceive of a more terrifying experience than this sudden encounter with a blinding glare of light and cannonlike report at a distance of 10 or 11 feet. This is the one objectionable feature of camera-hunting at night.

I am often asked whether it would not be possible with a second camera to photograph the animal's reaction to the flash. It can be done, it has been done, but I do not want to do it.

The charm, as well as the value of these pictures, is in their capture of the un-



EVEN BIRDS MAY BE BAGGED BY THE FLASH-LIGHT PHOTOGRAPHER

Although this picture was made during the day, the forest was so dark and the exposure so rapid that it resembles a night flash light. The beautiful white snake hawk was attracted to the trip-wire by a fish head.

suspecting animal as it prowls the forest on its nightly beat. To yield to our curiosity to see "what happens" is to destroy this feeling of seeing while unseen and, at the same time, to take unfair advantage of the animal. It is bad enough to frighten a creature; to photograph it in the act of responding to the uncontrollable impulse of fear is adding insult to injury.

Another puma (see page 340, lower) is distinguished by the large amount of black on its muzzle. It is apparently a full-grown female, perhaps the mate of the one above, though this is pure surmise.

HOW A UNIQUE PICTURE WAS OBTAINED

The left forefoot has crossed the wire, which was evidently sprung at the next step. No attention whatever was paid to the banana tied to the wire with white cord, and it remained for a Baird's tapir to take firm hold of this fruit and give the wire a tug which resulted in the unique picture shown on page 339.

Mice, rats, agouti, birds, even bats have automatically recorded themselves on this

camera register. But there are other inhabitants of Barro Colorado who have evaded it. There is the collared peccary, so common that we see it almost daily, but so wise that thus far it has dodged the camera wire. There are the exquisitely shy forest deer, the paca and the great bushy-tailed anteater. Above all there is the jaguar, king of American cats (see, also, illustrations, page 336 and above).

Aside from their importance as pictorial records, the chief value of these pictures is the graphic evidence they afford of the primitive character of Barro Colorado's fauna. A satisfactory study of the relation of an animal to its surroundings, physical and organic, can be made only when these surroundings are essentially natural. The removal of but a single species may affect the entire fauna. The introduction of a species may be followed by equally far-reaching results. In other words, the origin of structure and habit, the function of form and color, should be studied where the conditions of life have been undisturbed.



ARGONAUTS OF THE FOG

© Underwood & Underwood

The gallant crew of the *America*, heroic in the face of numerous adversities, not only added a notable chapter to flying annals, but also recorded valuable scientific data for transocean flying of the future. From left to right: Bertram B. Acosta, pilot; Commander Richard E. Byrd, leader and navigator; Lieut. George O. Noville, engineer and radio operator, and Bernt Balchen, relief pilot and mechanical assistant.



HE TOOK HIS OWN PICTURE IN THE MIDDLE OF THE NIGHT

Only the clouded leopard of Sumatra rivals the ocelot as the most beautifully ornamented of four-footed beasts. Against a smoky pearl background, the black markings develop from mere dots and speckles on feet and legs to the large, varishaped ocelli on flanks and back.



AN OCELOT FOLLOWING A TRAIL, THROUGH THE JUNGLE

This most beautiful of the medium-sized cats is a nocturnal forest dweller that subsists largely on birds and monkeys. Although a few have been tamed, ocelots are not usually dependable in captivity. They revert too frequently for comfort to their primitive habits.



© Publishers' Photo Service

DEVIL'S TOWER: A PROTRUDING RIB OF THE EARTH

This remarkable projection, in the Wyoming portion of the Black Hills country, is known to Indians as Mato Tepee. It strikingly demonstrates Nature's methods in molding and shaping the earth's surface (see text, page 305).

oned territory. The greater portion area is level and fertile and supports an excellent growth of grass. Thousands of cattle and horses have grazed in this region in the past, and in recent years stock raising and dairying have been carried on successfully in many sections. The abundance of good supplies of water and the sinking of shallow wells has helped to facilitate settlement. Close to what was once considered desolate homes have now been established. From the best vantage points from the surrounding view the strange panorama which

the Bad Lands presents is the cedar-covered top of Sheep Mountain. In one direction is a grassy flat with its browsing cattle. On all other sides Nature has crammed foreground and background with a jumble of weird but magnificent carvings. An outstanding feature is the Great Wall, all that is left of one level of the deep gravels and clays at which the forces of erosion have gnawed for ages. Flanking it is an intricate network of cliffs, domes, wedge slopes, and buttresses. Along the Wall itself rises an interminable series of towers and spires.

tests valiantly. She had been made st to mooring masts, she who loved the erty of the sky, and had courageously fied the storms in France, in Russia, l in Bering Sea; yet not one single t of her elastic frame had given way. e had defied wind, snow, cold, rain, and g. Now she lay motionless and help- s on the white snow field.

Only one who had seen that airship come into existence and had lived for 176 ours in her cabin, from Rome to the orth Pole, from the Pole to Alaska; only ne who had accustomed oneself to consider her as a living thing, could realize ow heartless it seemed that it was I who ad struck her down, at the triumphant close of her wonderful trip. What bitterness in the cup of joy of our triumph! Thus ended our stupendous adventure.

THE POLE'S SURRENDER TO MAN

It is interesting to review the history of North Polar explorations in the last 30 years. In the first line of attack have been the Italians, the Americans, and the Norwegians.

In 1893-96 Nansen reached $86^{\circ} 14'$ north; a few years later, in 1900, the Italians, led by the Duke of the Abruzzi, pushing farther, touched $86^{\circ} 34'$. The exploration contest by means of sledges was continued and brought to a victorious end by Peary, the American, who, in 1909, finally reached the Pole.

Later on, when man turned to aerial means to conquer the Arctic secret, we again find Norwegians, Americans, and Italians cordially competing in scientific effort.

Amundsen, in 1925, flies as far as $87^{\circ} 44'$ for Norway; one year later, Byrd, the American, on daring wing, reaches the Pole, and only 48 hours later, our airship

retraces the path of the American and also attains the Pole.

And this time the ship designed, built, and prepared in Italy and commanded by an Italian officer was carrying on board all three together—the flags of America, Italy, and Norway. And after having dropped them down at the North Pole, on the threshold of the immense unexplored region, our airship was the first to cross the Polar Sea, reaching the Pacific.

If Italy to-day is proud that her ship and her men have accomplished the first transpolar flight; if we are proud to have bound Italy and America together with an amazing aerial route, the plaudits of the civilized world should also go to Amundsen, the Norwegian, who gave his name and the benefit of his vast Arctic experience to the undertaking; to his modest and capable associate, Lincoln Ellsworth, the American, and to all those who coöperated in the technical and financial organization of the expedition. We of the Italian contingent are especially proud that it was Premier Benito Mussolini who fostered the undertaking and gave for it the ship and the men to command her.

After centuries, the dream of old Italian navigators to reach the Pacific across the north, starting from the Mediterranean, is at last realized. This is why we Italians are very grateful to Norway, that small but glorious country, which with her initiative gave us the opportunity to bind Italy and America together with a most amazing aerial route.

We are happy and proud that all along this aerial route of 8,500 miles across Europe, the Barents Sea, the Polar Sea, the Bering Sea, and Alaska, we carried on the front of our commander's cabin the "fascio littorio," symbol of the old, eternal Rome and of the new Italy.

INDEX FOR JANUARY-JUNE, 1927, VOLUME READY

Index for Volume XLI (January-June, 1927,) of the National Geographic Magazine will be mailed to members upon request.

STALKING THE DRAGON LIZARD ON THE ISLAND OF KOMODO

BY W. DOUGLAS BURDEN

THE following 21 photographs were taken on a scientific expedition of the American Museum of Natural History to the Lesser Sunda Islands in Malaysia. The primary object of this expedition was the quest of the dragon lizards of Komodo, the largest lizards in the world, which were first reported in 1912 by P. A. Ouwens, a Dutch scientist of Buitenzorg, Java.

As there are many interesting problems of a zoögeographic nature to be worked out in this region, general collecting of reptiles and amphibians was an important part of the program.

The Sunda Islands are volcanic, built up from the bottom of the sea by a successive series of flows. The eruptions of lava have arisen along the axis of the Sunda Fold, a great arc in the earth's crust extending for more than 3,000 miles, from Sumatra to the Philippines.

Although Bali, Komodo, and Wetar belong to a single group of islands, the extraordinary differences in the people who inhabit them and in the character of the islands themselves are striking.

In Bali, a luxuriant toyland of coconut groves and paddy fields, we found an erupting volcano, an advanced civilization, and a people remarkable for their beauty and form. From Bali we proceeded on the *S. S. Dog*, an official yacht given to us by the Dutch Colonial Government, to Komodo, the home of the dragon lizards.

Komodo was relatively unexplored, only a few white men having landed there. With its fantastic sky line, its sentinel palms, its volcanic chimneys bared to the stars, it was a fitting abode for the great saurians we had come so far to seek. Deer, wild boar, water buffalo, and game birds were abundant on the island.

THE LARGEST AND OLDEST LIVING LIZARDS

With the use of baits we attracted the giant lizards, which flocked around in considerable numbers, so that we were able to observe their habits, select those which we wanted for a museum group, and catch others alive.

The lizards, which attain a length of 10 feet and a weight of 250 pounds, are known to scientists as *Varanus komodoensis*. They are vicious, carnivorous reptiles, which attack their food much as the great flesh-eating dinosaurs must have done, ripping off great chunks of meat with their sharp, recurved saw-edged teeth and swallowing them whole, bones and all.

The *Varanus* lizards first appear as a genus in the early Eocene, some sixty million years ago; so that we have here not only the largest, but also the oldest, of living lizards. But Komodo is geologically recent. Thus, an old animal is found on a young island. How did it get there? Whence did it come?

A VISIT TO WETAR

After five weeks of collecting and observing, we proceeded from Komodo to Wetar, situated at the eastern limit of the Lesser Sunda chain. As it arose out of the sea, the island appeared a vast mass of torn and splintered mountains. The central portion is unexplored, and small wonder, for the tumble of jagged peaks presents insurmountable barriers opposing the traveler's way.

Bali was inhabited by Malays practicing the Hindu religion; Komodo by a few Malay convicts exported there by the Rajah of Sumbawa. Wetar, on the other hand, is inhabited by Papuans, who belong to a large group of peoples classified by anthropologists as Oceanic Negroids. The Malays, being a mixture of Mongoloid-Polynesian, have no negroid blood.

At Wetar we camped on the shore, enjoying the luxury of sleeping *à la belle étoile*. Collecting proceeded apace until finally one fine morning we sailed away into the Banda Sea, homeward bound.

We had secured a large collection of reptiles and amphibians. Of the dragon lizards we had 14 specimens, two being alive. The rest were to be used for study purposes and for a mounted group in the new Hall of Reptiles of the American Museum.



Photograph by Mrs. W. Douglas Burden

A COOLIE CLIMBS A GUBBONG, OR LONTAR PALM, ON KOMODO

Everywhere on the island home of the dragon lizard these great trees stand like sentinels along the sky line. Below, in the distance, is Telok Sawa, where the *S. S. Dog*, of the author's scientific expedition (see opposite page), rode at anchor.



Photograph by W. Douglas Burden

IN THE PINNACLE DISTRICT OF KOMODO

The face of the Komodo landscape belies its true character. When the traveler has forced his way in among the rugged mountains, walking and climbing become very difficult.



A GIANT LIZARD ADVANCING TOWARD THE BAIT

Just so have his ancestors crawled unceasingly through untold millions of years across prehistoric lands.



Photographs by W. Douglas Burden

A LARGE LIZARD ABOUT TO BEGIN FEEDING ON A WILD BOAR CARCASS

The bait's curling tail can just be distinguished in the illustration below the larger lizard's neck.



AN EXILE FROM KOMODO

One of the specimens of *Varanus komodoensis* at the New York Zoological Park. Unfortunately, for reasons yet unknown, the big lizards that were brought to the United States alive soon languished and died in captivity.

Photograph by New York Zoological Society



Photograph by Mrs. W. Douglas Burden

WHEN "VARANUS KOMODOENSIS" IS SHOT HE COLLAPSES LIKE A PRICKED BALLOON

This specimen was a fair-sized lizard, weighing about two hundred pounds.



THE EXPEDITION'S FIRST CAMP ON KOMODO

Photograph by W. Douglas Burden

The hut occupied by the author and Mrs. Burden was open to the sea breeze. The roof of woven palm leaves was mellow and bearded with age, and it contained a rich assortment of crawling life, including pit vipers, scorpions, centipedes, and spiders. Indeed, a most interesting collection could have been made from this shelter. To Mrs. Burden's left is Lee Fai, the expedition's cameraman.



Photographs by Mrs. W. Douglas Burden

IN LIFE ITS FORKED TONGUE IS IN ALMOST CONSTANT ACTION
Each scale is overlaid by a plate of bone affording a magnificent armor,
which is, however, insufficient protection against bullets.



READY TO BE MOUNTED AS A MUSEUM SPECIMEN

Dr. E. R. Dunn, of Smith College, herpetologist of the Expedition, is
holding the skin of a small Komodo lizard.



Photograph by W. Douglas Burden

THE SEA YIELDS A MONSTER

Mrs. Burden with a large grouper (*Epinephelus pantherinus*) caught off Komodo. Much of the fishing tackle was lost before manila rope and a leader of chain were adopted. This fish made very good eating.



Photograph by W. Douglas Burden

AROUND A CAMP FIRE IN THE JUNGLES OF WETAR



Photograph by Mrs. W. Douglas Burden

A GREEN PIT VIPER ON KOMODO

While resting in the grass the coolie felt something wriggling against his skin. Under a fold of his garment he found this venomous creature, *Trimeresurus gramineus*, which he extracted gingerly, with many explosive grunts; then removed its fangs.



Photograph by Mrs. W. Douglas Burden

BALI IS NOTED FOR ITS ORNATE ARCHITECTURE

Temple gateways, with their characteristic graven deities, form the most pronounced architectural features of this enchanting island. Bali and Lombok are the only islands in Malaysia where the Hindu religion still holds sway.



Photograph by W. Douglas Burden

A BALINESE WOMAN COOLIE GOES TO MARKET

Beautiful highways connect the important villages of Bali. Along these thoroughfares the natives pour into the market place, which here, as elsewhere in the Orient, is the all-important center for barter.



Photograph by W. Douglas Burden

THE EXPEDITION'S PAPUAN GUIDE IN A CANYON OF WETAR

Such canyons, cut vertically out of ancient lava flows, make of the island a well-nigh impassable mass of splintered mountains.



Photograph by W. Douglas Burden

BATHING IN BALI

In the evening whole villages come down the leafy paths to watering places. Except for the inevitable sarong, Balinese ladies regard clothes as a mere encumbrance.



Photograph by Mrs. W. Douglas Burden

BALINESE DANCING GIRLS

The beautiful brocaded costumes and the golden headaddresses crowned with the sacred lotus flower are in striking contrast to the barren, dusty temple yards in which these little dancers perform.



Photograph by W. Douglas Burden

BALINESE COOLIE WOMEN BOUND FOR THE PADDY FIELDS

In Bali one never sees the thin, scrawny types of humanity so common in India. There is but slight variation from physical perfection. Everywhere the girls, like plump partridges,



Photograph by W. Douglas Burden

THIS LAVA FLOW ON BALI DESTROYED A VILLAGE

When photographed this fresh lava flow, 25 feet high, was still steaming as it rolled relentlessly forward from Batur Volcano. It annihilated the settlement of Batur on the mountain's slopes.



Photograph by Mrs. W. Douglas Burden

CAPTURED BY HAND BENEATH THE WAVES

This green turtle was caught in the sea by Malays, who dived after it, struggled with it under water, and finally emerged with shouts of glee, dragging their prize up on to the beach.



Photograph by W. Douglas Burden

FEEDING A BABY CUSCUS ON WETAR ISLAND

This arboreal, nocturnal, prehensile-tailed marsupial resembles the American opossum. Such little creatures are caught barehanded in the tree tops by the Papuans.

TRACKING THE COLUMBIAN GROUND-SQUIRREL TO ITS BURROW

Loss of Millions to Crops and Danger of the Spread of Spotted Fever Necessitated Study of Peculiar Rodent of Western North America

BY WILLIAM T. SHAW

ASSISTANT ZOÖLOGIST, WASHINGTON STATE EXPERIMENT STATION

With Illustrations from Photographs by the Author

EXTENDING widely over western North America, from California north into Alaska, thence far into Siberia, is a genus of ground-squirrel known as *Citellus*. To it belong numbers of species, many of which are represented by such multitudes of destructive individuals as to make their presence in a territory a matter of economic concern.

An annual loss of upward of \$10,000,000 to the crops of the United States, the possibility of its transmitting the spotted fever in Montana and the bubonic plague in California and other southern and western States are considerations which have moved the Government to take serious steps toward its extermination.

The squirrels belonging to this group are more or less truly ground-squirrels, living in elaborate burrows or dens. They inhabit the prairies, the sage and bunch-grass plains, wherever there is sufficient vegetation to support them. The Columbian ground-squirrel (*Citellus columbianus*) is the species found on the higher grass plateaus of eastern Washington and parts of Oregon and Idaho. It is to this species that close study has been given.

FACING THIRST, THE SQUIRREL GOES TO SLEEP

Timid mammals, living upon the surface of the earth or among the branches or trunks of trees, present difficult problems of study. When, however, the greater part of their life is spent in tortuous tunnels or, as some one has expressed it, in "The underground City of *Citellus*," the problem becomes even more difficult.

The Columbian ground-squirrel is an active, nervous, sun-loving, gray-brown

animal about the size of the eastern gray squirrel; differing from it, however, in that its body is less lithe, its tail much less bushy, and its ears noticeably short. In slovenly cultivated wheat areas it soon becomes startlingly abundant; for, where not checked, it thrives with the raising of grains and alfalfa.

The ground-squirrel does not need water; it prefers succulent vegetation for the necessary moisture. This fact is responsible for the great damage done by it to growing grain; for, in attempting to obtain the desired amount of food and moisture from the tender stems of the developing wheat, it soon converts a waving field into a wilted, broken stubble.

BEGINS A SIX-MONTHS' SLEEP IN SUMMER

In mid-July a drought comes over the land of its habitat, and the squirrel can no longer find a trace of green vegetation. It would choke from sheer thirst, but instead it goes to sleep!

This interesting adaptation might fittingly be called hibernation were it not that it is begun in midsummer. About the first of July the numerous family of May and June gradually disappears until, in the steady heat of the early August days, not a squirrel is left; nor are they seen again until the snows of February are melting.

During this interval they are found in a remarkable state of death-like sleep. Their normal temperature, which ranges about 98° F., falls to the remarkably low point of 40° F., and in a cold, clammy condition the animals exist for weeks at a time, exhibiting the merest traces of life, and in the latter stages of the long sleep developing a startlingly death-like



PHOTOGRAPHS OF A COLUMBIAN GROUND-SQUIRREL FAMILY TAKEN WITHIN
THREE WEEKS

One of the remarkable features of this squirrel is its rapidity of growth. The picture at the top was taken on April 1, the middle picture shows the same family on April 10, and the bottom shows the brood on April 22. The animals more than doubled in weight during the last 12 days.



TWENTY-NINE DAYS OLD

This is the same family of squirrels shown on page 588. The rodents are now practically fully developed, though immature, and have come out of their nest into the daylight. They respond quickly to the call of the mother, attempt to bite if injudiciously handled, and altogether are quite grown up. On this date they ate both carrots and grass, having previously relied upon the mother for nutrition. While being photographed they gave an exhibition of stretching in the warm sun, which they dearly love.

limpness which makes one marvel that such objects could ever again regain warmth and form and life. This they do, however, sometimes in the surprisingly short space of a few hours.

To understand this strange life cycle the better, we should take it at the height of its activity. Walking over the wintry stubble of the Palouse River plains on a mid-February day, no signs of life are to be observed in any direction. Countless sleeping domes of volcanic ashen soil, now piled high with a winter's drift of snow to the steeper northern slopes, wind-swept and patchy to the south, lead away to a cold blue-gray line of mountains in Oregon; yet it may be only a few days before these same southern slopes are alive.

THE SQUIRREL WAKES LATE IN FEBRUARY

It was in the burning heat of an August day that the squirrels went to sleep; now, with the long night past, they awaken to the strange task of liberating

themselves from the frozen crust of winter. Soon scurrying little creatures are everywhere.

The end of February is the awakening time, and time is life to the squirrel. He must be stirring. In the interval against the returning of a sun-parched August day his family must be born, reared, and allowed to develop to such a stage as will safely carry the young past the dangers of their first winter's hibernation—all this in a scant five months.

By March to the more mature squirrels are mating, even at a time when the immature individuals of the previous year are still in their hibernating dens. The first of April finds new-born young in the nest, but it is not until nearly a month later that, on a bright sunny morning, one may see dainty, fascinatingly fluffy little creatures, all crowded wonderingly about the same small door, venturing scarcely an inch away, and ever delicately responsive to the danger call of the mother.



A NEST OF YOUNG WILD SQUIRRELS

Much of the data concerning the life history of the Columbian ground-squirrel could not be obtained by a study of the animals in the open. A strip of original bunch-grass land alongside the campus of the Washington State Experiment Station was found to contain many old, unused dens of the squirrels. About this land trenches were sunk to a depth of six feet and walls were erected in these to a height considerably above the ground. These virtual cages measured 50 x 100 feet, and in them wild squirrels were released after being first branded and registered so that they could be easily recognized.

Here they remain for a few days only, exploring the great winding burrows of the summer dens in which they were born and playing in little squirrel-family tussles with their brothers on the sunny mounds about their doors; then a few days more of family life and the squirrel nest is shaken out. Now it is that they do such serious damage to the developing grain.

The country seems underlaid with a vast network of disconnected squirrel dens, many of them at times unused, but, in places where a firm soil exists, capable of maintaining their integrity for years. Their use or disuse depends to a large extent upon the presence of one of their mammalian enemies, the badger, or upon the war waged upon them by man.

These young squirrels, together with the adults, scatter about over the fields, seeming to know by instinct where the old dens exist, even if to us all surface indications have been effected by plow and harrow. They soon open these unused deserted places, and shortly the fields of

wheat begin to show circular areas of desolation.

A SQUIRREL CAN CONSUME 500 WHEAT STEMS A DAY

With advancing season and maturing fields comes a cessation of rain. In the days of virgin bunch grass the squirrels met this adverse period with a trick they had learned of cutting in the side of the grass stem and nipping out the tender, succulent part which served them with both food and drink, for in many of these stretches of bench land surface water did not exist. It was but a step, then, to apply the same instinct of food-getting to the wheat.

This period, just before the ripening of the grain, is a time of great loss to the ultimate yield. Experiments with squirrels under fairly normal conditions show that they may consume daily about one-third of their weight at this season, and this would be equivalent to the destruction of 500 wheat stems, and consequently



AN ORPHAN

In the cages built around bunch-grass land near the Washington State Experimental Station, released squirrels were permitted to follow a life of bunch-grass liberty, yet under slight restraint, so that they disclosed, point by point, the secrets of their hitherto obscure life.

heads, per day to the squirrel, provided they fed upon nothing else. Then follows some destruction to the actual grain itself, for its fattening properties, and the damage is done. Drought returns; the squirrels must begin their long sleep.

These observations apply to the country about Pullman, Washington, with an elevation of 2,500 feet above sea-level. Twelve miles to the west, in the Canyon of the Snake River, with an elevation of about 600 feet, these activities begin nearly a month earlier, and so vary with the altitude throughout the range of the species in the State.

TRYING TO UNEARTH THE FACTS ABOUT THE LONG SLEEP

Perhaps the most arduous task connected with all the life study was that concerned with the findings associated with the long sleep. Tired, thirsty, and unsuccessful was our return from each day's effort during the first fall. Where, only a few days previously, scores of squirrels swarmed the fields, now there was none; yet in the returning spring they reappeared in abundance. The fol-

lowing autumn we renewed the unsuccessful search and abandoned it only when November storms settled down.

True, we were working against odds, for the badger, the squirrel's natural mammalian enemy, was also abroad. Where he had dug it was too late, and where he did not work there seemed a good reason for our not trying. We were learning, however, and long before reward came in finding a wild squirrel in hibernation, we had formed a correct idea of where and how he would likely be discovered. Here and there throughout the dens we were running across certain moisture-proof, jug-shaped cells, of surprisingly uniform dimensions, which we correctly judged were hibernating cells.

So cleverly did they hide themselves that it was not until the second fall had closed without success and we were beginning the excavation of the twenty-sixth den, in the early part of the third season, that we found a squirrel in the condition of semi-estivation. This was in mid-August. They had been in estivation scarcely ten days and our find was not yet dormant—only drowsy.



VERTICAL SECTION OF A HIBERNATING SQUIRREL AND DEN

This squirrel was found November 15. He was partly awake, as were all discovered previous to this date. He is sitting just outside of the neck of the hibernating cell and just above the drain which runs down and to the left. The round circular patch of earth immediately above the squirrel is a plugged burrow filled with the lighter-colored soil.



A HIBERNATING SQUIRREL IN MID-DECEMBER

Found sitting on the flat of his back, tightly curled *vertically*, not horizontally, as is customary with a cat or dog. The top of his skull is flat in his lap. At the moment he was photographed he was beginning to revive and had raised up a little.

In this discovery we established the truth of our surmise regarding the hibernation cell. Here, at least, was a beginning. Again we persevered for more data and were partially successful in the third season, but it was not until the fourth winter that results of value were obtained.

A NATURALIST'S FIELD NOTES

On one occasion we started out to work on a bright December morning. Of that day the field-notes say:

"We had planned to begin work early, in order that we might make use of the precious winter light for photography. At 6 o'clock a light wind was blowing, but at 7 conditions looked so much better we decided to brave it.

"Shortly the wind began to increase and by noon was blowing steadily and strongly. With its increasing strength came an ever-thickening cloud of dust out of a desert country miles to the southwest.

"At noon we built a fire in the snow-free excavation we had made. In order to strike a light, we had first to cover completely with coats and crouching men the kindling pile of shavings. Here we sat about the fire, some of the party almost blinded with smoke, others singed at times by the wind-swept flames. Dust and fine sand from the diggings sifted into the skillet and coffee-cups, leaving a fine precipitate in the bottom. Soon no trace of the fire remained, other than the red fire-burned soil. Ashes there were none, all having been sucked up by the terrific blasts."

On another December day when we were successful, the field-notes have the following:

"At 2:15 p. m. Richardson, a new man on the job, was working near the surface, about the center of the den. Presently his shovel cut cleanly through the moist earth and uncovered, or rather sliced off, the top of a large open burrow. No hole appeared at the surface of the ground.

"The freshness of the burrow at once attracted attention. It was smooth-walled and fresh-looking and bore no trace, as in other unused winter burrows, of fuzzy, sprouting rootlets.

"The burrow was dropping with a steep slant. It was followed carefully in vertical section until it struck a horizontal burrow going both ways. To the left the

hole was plugged concavely with what appeared to be black surface dirt, which may have come from the vertical shaft. To the right it sent a branch down into a drain-like structure; then continued straight on.

"As far as my arm could reach in this burrow, which came up slightly, I could barely touch some nest material. A little of this was drawn out and found to be made up of rather old-looking bits of broken straw. We now tried to cut through the hard clay to the nest.

"A drain shaft next revealed itself, while the burrow continuing beyond it raised slightly, as though it might be draining a hibernating cell. All of these indications were exactly as they should be—even excitingly so.

"The strained length of my fore-arm permitted my extended finger-tips to touch, rather uncertainly, a little bit of dry nest material. Yet it was old, and not new, coarse, wild grass, of which the outside of the typical hibernating nest is usually constructed. This was an unfavorable sign. Between us and the nest lay a heavy mass of hard subsoil.

THE END OF THE QUEST

"Would this be the strike? Photographic light was fast running out of a short winter day. It was indeed a race with night. With a will the workers heaved out a space for the camera. One ran for firewood with which to warm the operator's finger against the frosty air.

Carefully the heavy clay was shaved away from the location of the cell. Suddenly its upper wall shelled in, and there, from the little round hole in the nest material, lay the fuzzy gray tail-tip of a soundly hibernating ground-squirrel.

"The nest was very warm and dry and perfectly arched over, though much more matted in the saucer than in the ceiling. The bottom of the nest was made of rather fine grass and some dry, dusty earth, in which were buried over 100 bulbs of the wild onion. This squirrel lay in the nest flatly on his sacrum, curled vertically, with the flat top of his skull pressed into his lap—a strangely uncomfortable position."

Our time had come! For months we had followed this quest. All this winter day we had toiled for it, and now, in the



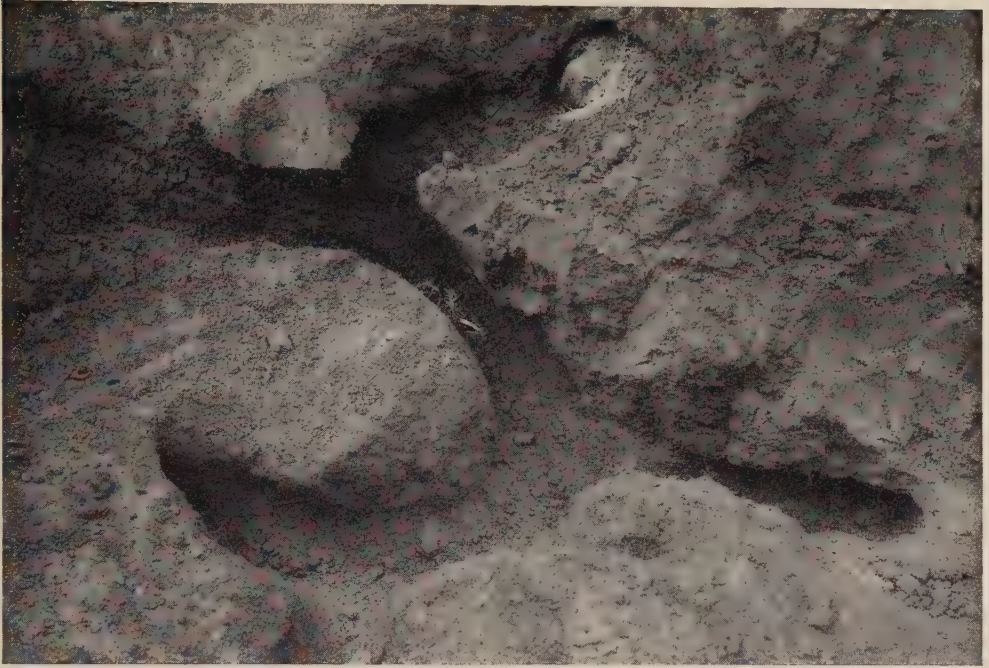
EXCAVATIONS MADE IN SEARCHING FOR HIBERNATING SQUIRRELS

At first, for fear that they were missing the squirrels, the investigators carefully followed every burrow. Later, before beginning the work of careful excavation, deep trenches were dug down to subsoil completely around the main body of the den for fear the squirrels might awaken and escape through some radiating burrow. A fairly large den may cover a radiating area of 30 by 40 feet.



THE VERTICAL SECTION OF A HIBERNATING DEN

From the knife at the left is, first, the exposed nest; next, the round hole leading upward for the spring exit; and then the drain leading downward.



COLUMBIAN GROUND-SQUIRREL'S DRAIN

Associated with the typical hibernating den is a most remarkable adaptation intended to protect the squirrel from all ordinary danger of being flooded. It consists of a drain or series of connected drains leading away from the hibernating cell, and is so cleverly constructed that water poured in any of the burrows is carried safely past the hibernating nest.



VERTICAL SECTION OF THE SOIL, SHOWING THE DEPTH TO WHICH THE BURROWS GO
The burrows usually spread out when they strike the harder subsoil, forming a network over its surface and sometimes penetrating it for a short distance.



THE DEN OF AN IMMATURE HIBERNATING SQUIRREL, TREATED WITH CARBON BISULPHIDE (SEE TEXT BELOW)

The squirrel had put in a plug, just in front of the cotton, probably for the night, to exclude cold air. Notwithstanding this barrier, the gas had penetrated the plug and killed the animal in its nest, as shown in the vertical section of the den.

twilight, we obtained our first picture of a wild hibernating ground-squirrel, after a search of three years.

COMBATting THE SQUIRRELS WITH GAS

While making a vertical section of a hibernation den for the purpose of photography, the idea suggested itself that some use might be made of these closed-in dens for the extermination of the animals when they awakened in the spring.

In the large summer dens the squirrels are at liberty to shift about at will, through a series of tunnels, with a capacity in some instances of nearly 300 feet of open burrow, together with many tunnels partially filled with loose earth, capable of being dug through rapidly or kicked up as a barrier in times of danger.

But it occurred to us that a gas might be used in the *hibernating* dens with deadly effect, for these contain not more than *seven* feet of burrow in contrast to the 250 or 300 feet of open tunnel in the summer den.

With the discovery of a shaft indicat-

ing where the spring exit would be, we realized the possibility of using the hibernation den as an aid in control methods. When, in February, small round holes began to appear, we entered upon our work of control.

Carbon bisulphide, an inexpensive liquid in its crude form, readily volatilizes when exposed to the air, becoming a poisonous gas, suffocating in its effect. This substance when introduced into the exit of the hibernating den immediately forms a heavy, deadly gas, which sinks at once into the recesses and results in a painless anesthetic death to the animal.

This substance has long been used against many forms of injurious animal life, and has been employed with effect against squirrels, even in the labyrinths of their summer dens; but its use in these restricted hibernating dens is proving wonderfully effective. The winter den is indeed a death-trap.

A vital principle of this method of destruction is that the squirrels killed are destroyed *before* the breeding season.

BATS OF THE CARLSBAD CAVERN

BY VERNON BAILEY

BIOLOGIST, BIOLOGICAL SURVEY, U. S. DEPARTMENT OF AGRICULTURE

BATS—celebrated in art, story, and drama as emblems of evil and darkness, associated with Satan and the infernal regions, supposed to be teeming with vermin and prone to entangling alliances with ladies' hair—are one of our least-known and most-maligned groups of mammals; least known because they are highly nocturnal and rarely seen except in semidarkness, and because in daytime they hide away in dark places, which are rarely accessible except to prying naturalists.

Many intelligent people ask whether they are reptiles or birds, and my boy scouts always want to know whether I mean leatherwing bats or bull bats.*

So strong are superstition and imagination that constant reiteration of some of the well-known facts regarding the habits of bats seems necessary to an appreciation of their great value to man.

Bats are mammals of a very old and highly specialized group. They were hanging upside down in caves long before the first cave man came to join them; and, while they may not have acquired great mental powers, they have developed special senses of which man has little knowledge or appreciation. They have progressed along so many different lines that they now form one of the very large orders or groups of the mammals of the world, represented in America by numerous families, genera, and species.

Many of the families and genera are world-wide in distribution, and in G. S. Miller's latest list of the Mammals of North America 252 species of bats are given. Still, to most people a bat is a bat, without regard to a wide range of habits and structural differences.

BATS ARE CLAD IN FUR AND HAVE SHARP TEETH TO CHEW THEIR FOOD

Although clothed in fur instead of feathers, their powers of flight are comparable to those of birds, or even superior

* It seems almost unnecessary to say that "bull bats" are nighthawks, birds related to the whip-poorwill.

for their purposes. On their wide, elastic wings they can fly slowly or rapidly, and make the necessary short turns in air to capture their insect prey.

With minute eyes and apparently short range of vision, and even with eyes covered, they detect and capture their prey in the air, avoid all solid objects, or even the finest wires or strings stretched in their paths, and find their way through long and intricate passages with no trace of light to guide them.

Strangest of all, they wander far and wide over the country at night in search of food, and with unerring sense return at daybreak to the same place to sleep, and guided in some way unknown and incomprehensible to us, some make migratory journeys north and south over continental areas and wide stretches of ocean.

BATS FEED RAPIDLY AND CONSUME GREAT NUMBERS OF HARMFUL INSECTS

All of the bats of America north of the Tropics are entirely insectivorous, feeding upon and controlling the abundance of the night-flying insects, just as the birds do the daylight species. They feed rapidly and consume great numbers of insects; their stomachs are large, and after a half hour of feeding sometimes weigh a quarter as much as the whole animal. On the basis of only two full meals in a night, which may be far too low an estimate, bats would consume half their weight in insects every 24 hours.

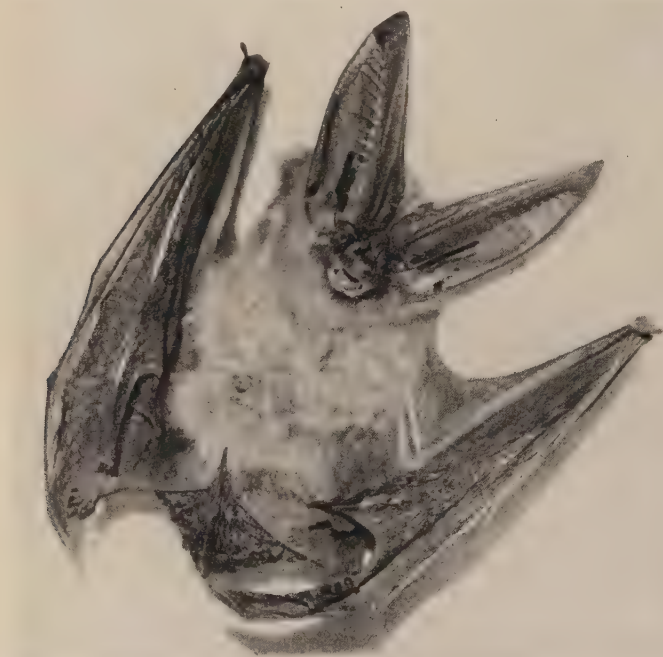
The insects eaten are not easily identified, as bats have good teeth and chew their food to the finest bits. The wing scales of moths and the hard particles—jaws, legs, shells, and wings—of beetles and flies form a large part of the recognizable stomach contents, but other night-flying insects are also extensively eaten. Mosquitoes, gnats, and such delicate insects are rarely recognizable in their food, but undoubtedly form some part of it.

So far as we know, the insects eaten are mainly our enemies and might, in unchecked abundance, injure or destroy our forests and crops.



A BAT WITH EARS UNROLLED AS IT AWAKENS

When the bat is cold and torpid in hibernation its ears are coiled up at the sides of the head. This one is warming up in the sunlight and the ears are slowly uncoiling (see, also, text, page 329).



Photographs by Vernon Bailey

BAT HELD IN FRONT OF CAMERA TO SHOW THE EARS

The antitragus, a slender filament inside of the ear, is supposed to be a delicate instrument for catching waves of sound or motion.

It is not improbable that bats are as necessary as birds in preserving that balance of Nature which renders this earth a reasonably comfortable habitation for man.

On close acquaintance, bats are found to be intelligent animals with very interesting habits. They are cleanly and not more subject to parasites than other animals. The chinchbug sometimes carried by them is not the species which infests our houses and causes so much annoyance.

There is no record of bats ever becoming entangled in the hair of anyone, and nothing could be further from their habits or inclinations. They will bite and fight savagely in self-defense, if captured and held against their will, but if handled gently they are quiet and intelligent, and in captivity soon learn to watch for the hand that feeds them.

MOTHER BAT CARRIES HER YOUNG IN FLIGHT

Most species of North American bats have but one young a year, born in June and carried about by the mother until old enough to fly and catch its own food.

The young are very large at birth, in some species weighing a quarter as much as the mother. They have no nests, but as the mother hangs head downward, by her hooked hind claws, the young cling to her body or are folded under her wings, where the two nipples are conveniently

arranged on the sides of the breast, just above the cradle of her warm, furlined armpits.

During the mother's flight the young, even when half grown, cling to her body and are carried about in her nightly search for flying insects. They fly considerably before becoming full grown, and apparently develop very rapidly from birth to the time of their first flight.

The mating season of most of our bats is in late summer or autumn, but the embryos usually show little development until the following spring.

Soon after the bats in the Carlsbad Cavern awoke from hibernation the embryos were still minute and in some individuals could scarcely be detected. In others they were perfectly formed, with a well-developed vascular system. By April 24 they were as large as small buckshot, and by May 7 the size of a .44-caliber bullet. They steadily increased in size until June 13, when they were fully developed, as large as marbles, and ready for birth. One examined on this date weighed 3.6 grams, while the mother weighed 13.6 grams.

The birth of these young, fully a quarter as large as the mother, would not be possible except for the low and widely separated bones of her pelvis. Even then it is almost inconceivable that she could give birth to a young comparable to a 33-pound, two-year-old child of the human mother.

THE BATS HANG IN VAST COLONIES FROM CEILINGS OF CAVERN

With but one young a year, it would seem that bats must live long to keep up their normal abundance, but there appear to be no available data as to their longevity or as to what becomes of them when their life cycle is closed. Generally they have



Photograph by Vernon Bailey

THE FACE OF AN ANGRY BAT

Caught and held in front of the camera against their will, these mammals express their rage with fierce looks and squeaks and use their keen little teeth on anything within reach.

few enemies, and their abundance is probably limited only by the normal food supply.

The bats of the Carlsbad Cavern are mainly the Mexican Free-tailed, *Tadarida mexicana*, the famous guano-producing species of Mexico and the southern United States. Their habits of roosting in enormous colonies in caves or buildings has given them a special value in the production of great quantities of guano, a product much prized as a fertilizer.

They differ from most of our northern bats in the projecting tail, which reaches about an inch beyond the attached membrane; in short, wide ears, short, close fur, and a strong, musky odor peculiar to the species. They are not the only species of bat in the great cavern, but are so numerous that the others are little noticed (see illustrations, pages 325 and 327).

Their numbers vary at different seasons, apparently reaching the maximum in late summer and early fall, when they gather for the winter's sleep, and the minimum about the first of May, when



Photograph by Vernon Bailey

THE FRINGED BAT (SEE TEXT, PAGE 330)

This is one of the Small-eared Bats, *Myotis thysanodes*, widely distributed over the southwestern United States and Mexico, and a regular inhabitant of caves.

many have left for lower country and better feeding ground.

On a warm evening in early May, about 10,000 came out of the cave—their numbers partly counted and partly estimated. From descriptions of the dense cloud of bats coming out in August, the numbers must run into hundreds of thousands, if not to millions, and such estimates would be necessary to account for the great deposits of guano taken out of the cave.

The conditions of temperature, moisture, and space in this great cave seem to suit the bats better than those in any other of the numerous smaller and drier caves of the region. The enormous rooms in which they cling for their winter sleep to the ceiling 150 feet above the floor are very uniform in temperature, varying only from 55 to 60 degrees Fahrenheit, from early March with its freezing weather to hot days of May, and is said to show no noticeable difference in temperature throughout the year.

The air of the cave is moist and heavy with the musky odor of bats, an odor that with a favorable wind can be detected outside half a mile from the entrance. To the bats this odor may be recognizable at a much greater distance and serve a

very useful purpose in bringing them back from their nightly wanderings and from their seasonal migrations.

GUANO DEPOSITS COLLECTED DURING
THOUSANDS OF YEARS

The guano deposits, composed entirely of insect remains, reach back into geologic ages, lying under huge stalagmites that have been thousands of years in forming.

When first brought to commercial notice, in 1901, the guano filled some of the largest rooms to a depth of 100 feet, coming up nearly to the natural openings and sloping away for hundreds of yards over the cave floor. From all records now available, the estimates of 100,000 tons of guano taken out of the cave seem not too high. Most of this has been shipped to the California Fertilizer Company at San Bernardino, California, and sold at prices ranging from \$20 to \$75 a ton.

The guano remaining in the cave would make but a few carloads, and most of it is old, mixed with earth, and of low grade as a fertilizer.

A special effort was made to determine the rate of deposit of the guano, but with little satisfaction, because of the cold weather of March and April, the conse-



ON THE WING, THE GUANO BATS ARE STRONG AND SKILLFUL FLIERS (THIS SPECIMEN AND ITS QUARRY HAVE BEEN POSED BY THE PHOTOGRAPHER)

They hunt their insect food at night, capturing and devouring beetles, moths, flies, and a host of winged insects of nocturnal habits. The guano deposited under their roosts in the caves is composed entirely of insect remains. How many insects would be required to make 100,000 tons of guano? (See text, page 324.)



Photographs by Vernon Bailey

THE LARGE BROWN BAT, ABOUT TWO-THIRDS NATURAL SIZE

This is the commonest bat in Slaughter Canyon, near the Carlsbad Cavern, where great numbers come to drink at the water tank in the evening. In summer this bat lives mainly in the northern, forested regions of the continent, but in winter it is probable that it seeks more comfortable quarters in the south (see text, page 329). Note how the knees of a bat bend backward.



Photograph by Vernon Bailey

A MOTHER RED BAT AND HER FAMILY OF FOUR YOUNG

This mother bat was brought into the National Museum just as she was found hanging to a twig in a maple tree. Each of her four young was clinging to a nipple with its mouth and to the mother's fur with its twelve hooked claws. The four young weighed 12.7 grams, while the mother weighed only 11 grams, so they were a little more than a quarter grown. They showed no inclination to let go, and it must be inferred that the mother carries them while flying in pursuit of insect prey until they are old enough to hang up in the tree and wait for her return, or to fly and catch their own food (see text, page 330).

quent inactivity of the bats, and the resulting slight deposits of guano.

I could not catch sufficient insects to satisfy the appetites of my captive bats, and thus test the rate of deposit. The bats evidently could not catch enough insects during the cool nights to fill their stomachs, which on the return to the cave in the early morning were not more than half full. Stomachs of bats coming out in the evening usually were empty.

Under the densest part of the bat colony, on April 29, a paper 20 by 30 inches was spread to catch the droppings. In 44 hours it caught 1,145 pellets, which weighed at first 5 grams and when air-dried 3.7 grams. These did not more than half cover the surface of the paper, so that a single layer of droppings about 2 millimeters thick would have required over 2,000 pellets and about 4 days of time.

The fact that in the three years since any guano has been removed from the cave there have accumulated no deposits more than three inches in depth would indicate a very slow rate of deposit, even where the bats are very numerous.

One inch a year of fresh pellets would certainly shrink to half an inch when disintegrated to dust and packed and settled into the solid mass of the old, deep guano, rich in nitrogen, phosphoric acid, potash, and other valuable elements of plant growth. Even under a large colony of bats, it would seem

that 50 feet of guano might well represent the food refuse of more than 1,000 years.

But for most of the bat colony this cave is a winter resort rather than a summer home. In other caves farther south, where the bats live both summer and winter, the rate of deposit is much more rapid. In a smaller cave near San Antonio, Texas, about 60 tons of bat guano have been taken out annually for 29 con-



PHOTOGRAPH OF A MOTHER RED BAT WITH WINGS AND TAIL, HELD BACK TO SHOW THE FOUR YOUNG CLINGING TO HER BODY (SEE, ALSO, OPPOSITE PAGE)



Photographs by Vernon Bailey

THE FREE-TAILED OR GUANO BAT

These bats belong to a mainly tropical family reaching into the southern United States, and are very different from our northern species in structure, habit, and odor. The tail projects about an inch beyond the attached membranes, the ears are short and wide, the fur close and oily. They have a strong, musky odor and are more extensively colonial than are any other of our North American bats.



Photograph by Vernon Bailey

THE LONG-EARED BAT, SOMETIMES CALLED THE JACKASS BAT, OR JACK RABBIT BAT

These bats are cave dwellers, but never in great numbers. A dozen or a hundred or a few hundred are sometimes found together in a cave, or in summer in an old building.

secutive years, and other caves have yielded comparable amounts.

A good productive bat cave has the advantage over a gold mine in being self-perpetuating.

But the real value of the bats lies in their enormous destruction of insect pests, which is well illustrated by a permanent yield of 60 tons a year of insect shells in one locality.

THE LONG-EARED BAT STUDIED DURING HIBERNATION

Besides the vast numbers of Free-tailed, or Guano, Bats, which hang close together under the roof of the highest room in Carlsbad Cavern and by their rank odor apparently keep other bats at a distance, there are about a dozen species that occupy, or have occupied, various parts of the cave or near-by caves and canyons. Of the 18 species of bats known in New Mexico, 13 have been found in this vicinity.

In the farthest, deepest room of the cave, where there were no living bats, numerous skeletons were found lying on the dusty floor. They were usually old and bleached, but some were dried mummies that may have been there for many years. Most of these were of the Guano Bats, but they included also bones of many other species.

The Long-eared Bats, *Corynorhinus rafinesquii pallescens*, one of the most interesting and spectacular species of the region, were found in considerable numbers in McKittrick Cave, some 20 miles farther north. On April 15, when first discovered, they were still in profound winter sleep, hanging head down from the low limestone ceiling and on the rock walls of the cool, dry rooms, their great ears rolled up in spiral coils like rams' horns on each side of the head.

Their bodies were cold and apparently lifeless, their respiration and circulation reduced to the minimum, and all the bodily functions greatly retarded. Unfortunately, I had no thermometer with me, but the temperature of the rooms was apparently about 60 degrees Fahrenheit and the bodily temperature of the bats approximately the same.

Here the bats had hung all winter, nourished by their store of fat and bodily fluids and still in good condition. When brought out into the warm air they soon uncoiled their ears, stretched their wings and legs, and when handled opened their little red mouths and squeaked protestingly. Some which were kept for several days in a cloth bag hung up in my room were warm and active during the daytime, but when the temperature dropped below 60 degrees, as it usually did at night, they rolled up their ears, became cold and torpid again, and in the morning were in a state of hibernation (see page 322).

The Large Pale Bats, *Antrozous pallidus*, are common bats of the region, but none was found alive near the cave, or nearer than Carlsbad, 26 miles distant. In summer they are generally found living in houses, barns, cliffs, and small, dry caves, but little is known of their winter resorts.

In Slaughter Canyon, about 15 miles west of Carlsbad Cavern, dozens of their decaying bodies were found in an iron water tank at the goat ranch, where they had fallen in while drinking and had drowned. The tank was about 20 feet across and only 5 feet deep, but these large bats evidently could not drink from the surface of the water so quickly as to be able to rise again before striking the sides. No smaller bats were found in the tank, although many came to drink.

A number of bat skulls or jaws were found among the owl pellets on the floor of the Bighorn Cave, in the west branch of Slaughter Canyon, where they may have been roosting, or may have been brought in by the Great Horned Owls which nest in the cave.

The Large Brown Bats, *Eptesicus fuscus*, were represented in the Carlsbad Cavern by an old skull and wing bones found on the floor of the deepest room, where they had lain for many years.

Among the numerous bats seen outside, flying about at night, they may have been common, but only in Slaughter Canyon were any specimens taken. Here they were apparently the commonest bat, coming in by dozens to drink at the water tank in the evening and approaching from the direction of the large, open Slaughter Cave near there (see page 325).

In summer these bats are found mainly in the higher, timbered zones in the mountains, from New Mexico to Canada, and across the middle part of the continent, where they are an abundant species, especially in the forested regions. It seems probable that they come down to this level to find comfortable winter quarters, either in the caves or far back in cracks and crevices of the canyon walls.

SILVERY-HAIRED BATS BREED IN CANADA

At Oak Spring, from which we obtained water for camp use while working in the cave, one of the Silvery-haired Bats, *Lasiorycteris noctivagans*, was obtained by Dana Lee as it came in to water, on the evening of April 12, and a few days later a couple of others were seen in Walnut Canyon, near there. Their very black color throughout renders them conspicuously different from other bats when they first begin to fly, in the early twilight, for the silvery frosting on the back does not show while they are on the wing.

They are northern bats of migratory habits, breeding mainly in the Canadian Zone of the mountains or far north, and moving, at least in part, to lower levels or lower latitudes for the winter. There are few records of their occurrence in New Mexico, but some of the caves of this region may afford just the right degrees of temperature and humidity required for their winter sleep.

Any cave that offers winter quarters for these defenders of our northern forests should be given special protection.

The House Bat, *Myotis incantus*, was represented in the lowest room of the great cave by several fragments of old skulls which may have been there for many years, but in another cave near Carlsbad about 1,000 of these bats were hanging to the low roof within easy reach of my hand. They were readily photographed in a very lively moving picture,

as they broke away from the solid mass in which they had been huddled together.

One of the Fringed Bats, *Myotis thysanodes*, was found in a rain barrel close to the open ladder shaft of Carlsbad Cavern. It is largely a cave-dwelling species, and this one may have come out of the shaft and, in attempting to drink from the water in the barrel, have fallen in and drowned (see page 324).

The Cave Bat, *Myotis velifer*, and the Little California Bat, *Myotis californicus*, have a general distribution over this region, but the only specimens taken at the cave were skulls picked up in the big dry room at the farthest end and lowest level. These remains and the traces of guano in this chamber are so old as to suggest a former entrance now closed or hidden.

The tiny Canyon Bat, *Pipistrellus hesperus*, easily recognized by its small size, whitish fur, and very black wings and ears, was often seen early in the warm evenings, flitting about in the big western doorway of Carlsbad Cavern, where it probably lived in the cracks and small openings of the cliff, rather than down in the dark chambers. It was also the most abundant bat along the canyon walls and at Oak Spring, just over the ridge, where hundreds came to drink every evening. Its very small size would suggest quite a different set of food insects from those eaten by the larger bats.

A jawbone of this little bat picked up with other bones from owl pellets under the nests of Great Horned Owls in the Bighorn Cave, in Slaughter Canyon, does not necessarily mean that they live or winter there, although this is probable.

The Great Hoary Bats, *Nycteris cinerea*, largest of our northern bats and conspicuous by their short ears and silvery-gray fur, are not common in New Mexico and occur mainly as migrants from their northern or mountain homes to southern winter grounds. They have been found as far south as Brownsville, Texas, and southern California, but where or how they spend the winter has never been known.

In summer this species is generally found during the day hanging head downward in some dense foliage of trees or bushes and, so far as we know, is not given to entering caves or buildings.

Wing bones of several individuals were found on the floor of the deepest, farthest room of the cave, which would suggest this as a wintering place for the species.

Jim White, for many years in charge of the guano mining operations of the Carlsbad Cavern, told me of finding a very large gray bat hanging in the leaves of a walnut bush in the canyon below the cave and making a fierce little noise like a miniature cat fight. This could have been no other than the Hoary Bat.

A MARVELOUS EXHIBITION OF POWER OF FLIGHT

The Red Bat, *Nycteris borealis*, has never before been recorded from New Mexico, but the southern part of the State is well within its range. Two old skulls found among other bat remains on the floor of the farthest, deepest room of the cave would suggest that this chamber farthest away from the colony of Guano Bats was used as a wintering ground by the Red Bat as well as by several other species. While mainly tree bats, hanging during the day in the leaves of trees or bushes, they are known also to enter caves and may seek such quarters for winter hibernation.

Unlike most bats, the females have four mammae, and two to four young have been found clinging to their mother, their combined weight considerably exceeding hers (see pages 326-327).

These mothers were found hanging in trees and were not actually observed in flight with their burdens of young; but the inference is that they must carry the young about with them in pursuit of their regular prey, flying insects captured in the air. Where is there another example of such power of flight by bird or beast?

Early reports that the bats were the only animal life in the Carlsbad Cavern have been disproved by the discovery of several other mammals and two cave crickets occupying its whole extent, while a number of insects, spiders, and a myriapod occupy the first large rooms, where there is still a trace of reflected light.

Many other mammals and some birds live in the gloomy halls of the entrance shafts, either permanently or temporarily, and still more in the immediate vicinity outside.

TO SEEK THE UNKNOWN IN THE ARCTIC

United States Navy Flyers to Aid MacMillan Expedition Under the Auspices of the National Geographic Society in Exploring Vast Area

WITHIN a few days of the time when this number of their Magazine reaches the members, an Arctic expedition under the auspices of the National Geographic Society will sail from Wiscasset, Maine, for Etah, Greenland. During the summer months it is hoped that many thousand square miles of hitherto-unexplored area north of Beaufort Sea will be revealed to the world by geographers bearing the Stars and Stripes.

With the approval of President Coolidge and the Hon. Curtis D. Wilbur, Secretary of the Navy, this work is to be undertaken by the MacMillan Arctic Expedition, with the coöperation of the United States Navy. The Board of Trustees of the National Geographic Society has appropriated \$40,000 from the Research Fund to aid in defraying the expenses. The leader, Donald B. MacMillan, well known to members of The Society, has been active in Arctic exploration since 1908, when he was one of Peary's lieutenants on the expedition which resulted in the attainment of the North Pole, April 6, 1909.

The MacMillan party will go north on two ships—the *Peary*, a converted French trawler, and the *Bowdoin*, a staunch craft which has already written its name large in Arctic exploration, having carried Commander MacMillan to the Far North on two previous expeditions.

By invitation of the city of Boston, the vessels will sail from that port for Wiscasset on June 17, Bunker Hill Day.

The trawler *Peary* will be used primarily to transport the United States Navy's recently perfected Loening amphibian airplanes, capable of landing both on the water and on the ice. The operation of the planes and Navy personnel will be under the direction of Lieutenant Commander R. E. Byrd, U. S. N.

The Navy is holding in readiness its two great airships, the *Shenandoah* and the *Los Angeles*, to send to the relief of

the expedition should it encounter unforeseen difficulties.

MANY BRANCHES OF SCIENCE TO BE REPRESENTED

On board the *Bowdoin* will be a group of distinguished scientists, including an ichthyologist, a geologist, and a meteorologist. Among the tasks of the first named will be the study of several kinds of salmon and trout.

The meteorologist will be an especially important member of the party, as a study of atmospheric conditions at various altitudes can be made with the aid of the Navy planes. His work will prove of value for the future, if commercial air lanes are established over Arctic regions, in flights from England and Newfoundland to Japan. Data may also be obtained which will aid in weather forecasting for the United States.

The unexplored area, which it is hoped can be penetrated by means of airplanes, with bases established on Axel Heiberg Island, lies between the Alaska Peninsula and the North Pole, and is shown on maps and globes by a white spot representing approximately one million square miles of the earth's surface.

Other unknown areas where explorations will be made include central Ellesmere Island and Grant Land, the northern part of the great Greenland ice cap, the northern part of Labrador, and the entire interior of Baffin Island, believed to be a land of thousands of lakes and bountiful animal and bird life (see map, page 674).

The headquarters of the expedition will be established at Etah. From this base gasoline and other supplies can be relayed to Cape Thomas Hubbard, Axel Heiberg Island, at the edge of the Polar Sea, for the use of the Navy's amphibian aircraft.

From Cape Hubbard to the center of the great unknown area is, roughly, 600 miles—a distance which could be accomplished by an airplane having a cruising



MAP SHOWING FIELD OF ACTIVITY OF THE MAC MILLAN ARCTIC EXPEDITION UNDER THE AUSPICES OF THE NATIONAL GEOGRAPHIC SOCIETY

The Peary and the *Bowdoin* will sail from Wiscasset, Maine, for Etah, Greenland, touching en route at Sydney, Nova Scotia, and Hopedale, Labrador. The main ship base will be established at Etah, and an airplane base will be established at Cape Thomas Hubbard, Axel Heiberg Island. From the latter it is hoped that the amphibian U. S. Navy planes can fly over much of the unexplored area lying between Alaska and the North Pole. Other objects of the expedition will be to explore by plane the great ice cap of northern Greenland, the interior of Baffin Island, and a portion of north-central Labrador.

radius of 1,200 miles. It is hoped that by the use of extra fuel tanks the amphibian planes can cover this distance in one continuous flight.

DENMARK CONSENTS TO STUDY OF NORSE RUINS

Through the courtesy of the Government of Denmark, to whom the entire Island of Greenland belongs, the Mac-Millan party will be permitted to study the remains of old Norse settlements established in the southern portion of the island some 1,500 years ago. It is esti-

mated that there are 100 farms of early Norsemen and some stone churches near Julianehaab, and some 90 farms and 24 stone churches built by the Norsemen in the vicinity of Godthaab. The reason for visiting and studying these ruins is to establish, if possible, a connection between the houses built by the Norsemen and those that have been found in Labrador, which, according to the Eskimos, were built by "strange people, who came in from the sea in open boats without masts and without sails."

Commander MacMillan will report all findings of the expedition by radio in telegraphic code to the National Geographic Society, and the news will be given immediately to the world through the daily press by The Society. In receiving the code messages from the Far North, the coöperation of American radio amateurs will be relied upon.

WILL MAKE ATTEMPT
TO BROADCAST TALKS
FROM THE ARCTIC

Effort will be made to have the spoken word from the expedition leader broadcast to American homes. The transmission of the radio messages, during the 24 daylight hours, across a hitherto "dead zone," by the new short wavelengths, will constitute in itself an experiment in communication of scientific value.

Of special interest to all of the members of the National Geographic Society, each of whom has a share in the financial support of the expedition, will be the provisions which are being made for photographing the wonders of the Far North. For the first time in Arctic exploration, natural-color photographs will be made. It is believed that these color plates of the marine life, the



THE LEADER OF THE MAC MILLAN ARCTIC EXPEDITION

The commander is rather successfully disguised by his snow goggles. He has in his arms three young eider ducks taken on Littleton Island, near Etah, Greenland, last July.

flora, including the beautiful "red snow," and of the experiments to record photographically the Northern Lights will prove valuable contributions to science.

Commander MacMillan's detailed account of the work of the expedition will appear in the NATIONAL GEOGRAPHIC MAGAZINE shortly after the leader's return to civilization.



Photograph by Donald B. MacMillan

EIGHT-YEAR-OLD ME-GISH-OO, OF NORTH GREENLAND

The present native population of Greenland is about 14,000 and is mostly confined to the west coast. Little Me-gish-oo shows the friendly, happy characteristics of her people (see also page 718). One of the objects of the MacMillan Arctic Expedition under the auspices of the National Geographic Society is to make a study of the Smith Sound Eskimos, to which tribe this girl belongs.

THE "BOWDOIN" IN NORTH GREENLAND

Arctic Explorers Place Tablet to Commemorate Sacrifices of the Lady Franklin Bay Expedition

BY DONALD B. MACMILLAN

LEADER OF THE MACMILLAN ARCTIC EXPEDITION, UNDER THE AUSPICES OF THE NATIONAL GEOGRAPHIC SOCIETY, 1925; AUTHOR OF "PEARY AS A LEADER," IN THE NATIONAL GEOGRAPHIC MAGAZINE

ONE of the objectives of the *Bowdoin* on the Arctic Expedition of 1923-1924 was Cape Sabine, on the eastern shore of Ellesmere Island, where, at the request of the members and Board of Trustees of the National Geographic Society, we were to place a tablet in memory of the members of the Lady Franklin Bay Expedition who died there of starvation in the spring of 1884.

The *Bowdoin*, named after my college, was built on the Maine coast especially for Arctic work. Although the smallest vessel ever to go into the Far North, she is undoubtedly one of the strongest, having been built of well-seasoned timber, oak-ribbed, oak-planked, covered with a five-foot encircling belt of ironwood, and a 1,700-pound steel plate on her stem to take the brunt of her battle with ice floes.

THE EXPEDITION REACHES ETAH

We sailed from Wiscasset, Maine, June 23, 1923, and after a voyage of numerous minor adventures, the *Bowdoin* rounded Cape Alexander and sighted Etah at midnight of August 7, with the sun bathing every promontory and ice cap in a soft yellow light.

The bold north shore, with its gentle green slope culminating in its 1,000-foot cliff, was beautiful, with its blues, greens, purples, and reds blending into the pattern of a gigantic oriental rug.

The waters of the fiord, placid as a mirror, reflected the contour of the bordering hills, strikingly black in contrast with the gleaming white of the glacier crowning the head of Etah harbor and dropping gently into the clear waters of Alida Lake.

The hush of midnight, which steals quietly over the Northland as the sun swings along the northern horizon, was broken only by the musical sound of falling waters.

One point alone was not attractive, the site of our home of 1913-1917. It seemed so strange, so unreal, to look up and find it gone! Thirty-five feet square, eight rooms, a large, comfortable living room, four bedrooms, a carpenter shop, generator room, dark room, all electrically lighted, with double windows, double walls—a real home to welcome us back from long, cold trips—now a flat, débris-covered slope, "a tragical vista of pathetic scraps."

The morning after our arrival we left Etah for Cape Sabine, 30 miles distant. There was not a particle of ice in sight from the crow's nest. Open water extended apparently to the Pole itself. When within 10 miles of Cape Sabine, however, ice seemed fairly to pop up out of the sea, and lay in one solid jam against Ellesmere Island from Cape Isabella northward. This disappearance and reappearance of drift ice is so astonishing that Newfoundland fishermen declare that it rises from the bottom and sinks beneath the surface.

Running along its edge, we examined the drift ice carefully for open water; it presented an unbroken front. I decided to return to Etah and await a more favorable opportunity to erect the memorial.

THE TRAGIC STORY OF THE GREELY PARTY AT CAPE SABINE

Upon the northern side of Cape Sabine is the site of the Greely Camp of 1883-84. The 23 officers and enlisted men of the Lady Franklin Bay Expedition, with two Eskimos, under command of Lieutenant Adolphus W. Greely, landed at Wade Point, 16 miles southwest of Cape Sabine, following their memorable retreat in boats from Fort Conger, 220 miles north. It was here that they fully expected to meet the relief ship sent by the United States Government.



GODTHAAB, CAPITAL OF SOUTHERN GREENLAND

This tiny "metropolis" has about 400 inhabitants and more modern buildings than most of the other settlements of the Danish colony.



Photographs by Donald B. MacMillan

THE WHALER'S LOOKOUT AT GODHAVN: DISKO ISLAND

This curious relic of 1782 is made of boards nailed to four large pieces of whale jaw. Seamen and explorers have cut their names on the hut's walls, and some of the dates go back to 1811. The cannon in the foreground was used to announce to the fleet the sighting of a whale or the rupture of the ice pack. Godhavn, the Lievely of English and Scotch whalers, is the capital of the North Greenland Inspectorate. In its harbor almost all American Arctic expeditions, and many British, have anchored.



Photograph by Donald B. MacMillan

KOO-KA-PING-WA EATING RAW WHITE WHALE MEAT

This flesh is a great delicacy to the Smith Sound Eskimo, while the oil, like that of the narwhal, is used for heating and lighting purposes.

A note left in a cairn at Cape Sabine advised the explorers that this relief ship had been crushed in the ice, but a cache of supplies had been landed. The party decided to abandon their partially constructed quarters at Wade Point to settle beside the cache, where a second ship would naturally seek them.

Then began a long and hopeless fight against cold, darkness, and starvation. When the sun first touched the roof of their wretched rock hovel on March 12, after its absence of five months, only one of the brave little band was missing, but six died in April, four more in May, and seven in June. When Schley reached their camp, on June 22, there were only seven survivors.

RADIO ANNOUNCES ARRIVAL OF THE PARTY

No tablet or memorial of any kind had ever been erected to these soldiers of the United States Army, who truly died upon the field of honor. But in the hold of the *Bowdoin* we were bringing a beautiful bronze tablet to be erected at Cape

Sabine by the National Geographic Society (see pages 700 and 706).

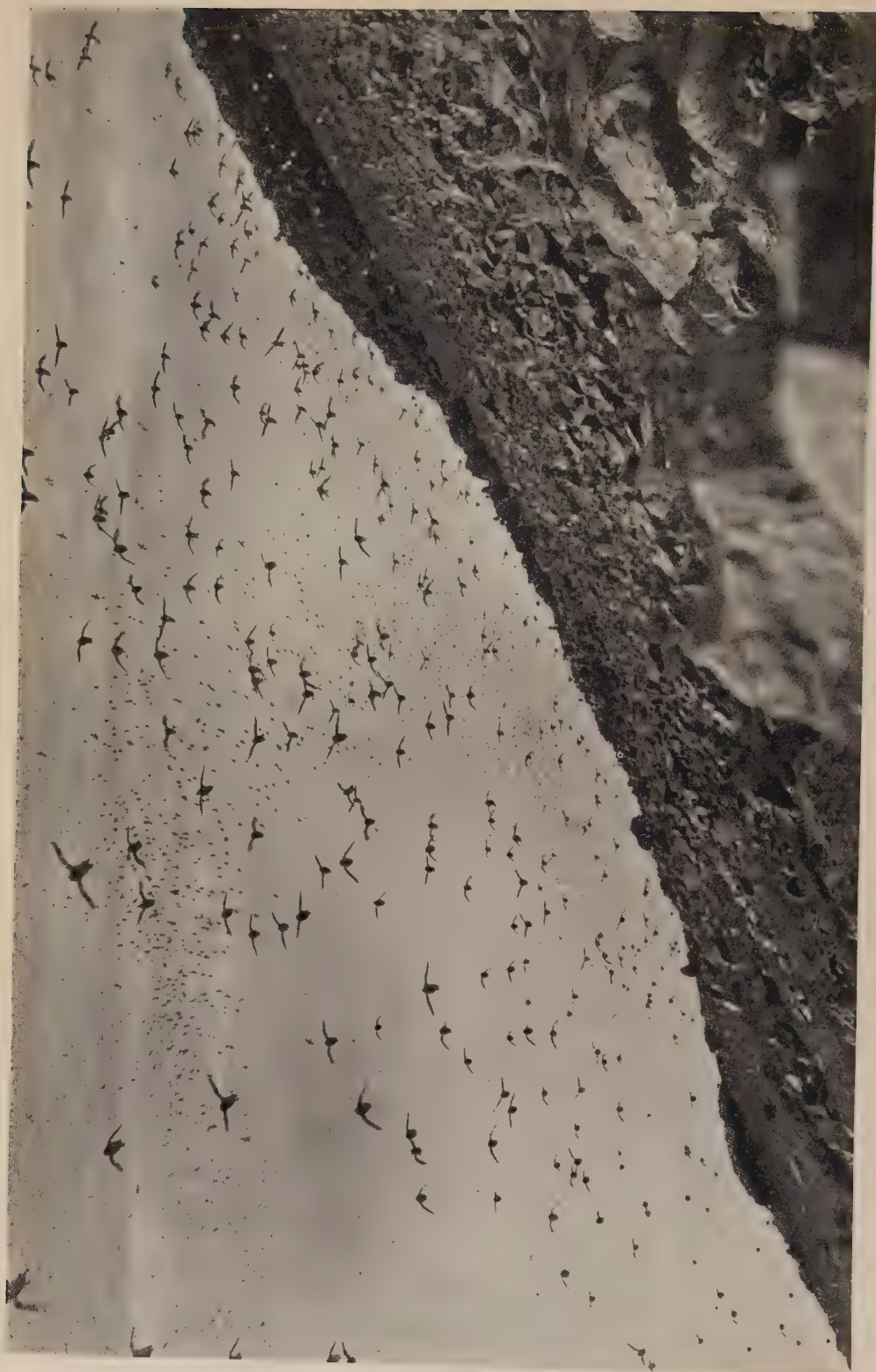
We established our winter quarters in Refuge Harbor, an ideal location, which had been utilized by the Kane Expedition of 1853-55.

Here we began unloading the *Bowdoin* on August 18, and on Sunday, August 19, through wireless telegraphy, we reported our arrival and the general good health of all the members of the expedition.

By September 6 the harbor was so firmly frozen over that my men, all new to the north, thought we were in for the winter. The next morning the ice had disappeared completely. So it continued, alternately freezing and breaking until September 22, when the thermometer dropped to 10 above zero, resulting in a fine layer of skim ice over the harbor.

By October 18 the hills were white with snow and harbor ice was strong enough to bear the men anywhere with safety. The *Bowdoin* was in her ice cradle for the winter.

The sun had been on its long journey south since June 21, each day a little



Photograph by Donald B. MacMillan

LITTLE AUKS ARRIVING IN THE VICINITY OF ETAAH ON MAY 15

Millions of these birds darken the sky for hours when they appear practically on the same day each year. They play an important rôle in the life of the Eskimos, who literally scoop them out of the air (see illustration, page 682). A winter's store of food is thus easily obtained by an Eskimo family, and the soft little skins make warm and comfortable garments worn next to the body. The little auk is known by many names—dovekie, sea-dove, bull-bird, ice-bird, sea-king and rofchie. It is known to the Eskimos as *Etah*. It is known to the Eskimos as *Etah*.



Photograph by Donald B. MacMillan

LITTLE AUKS ALIGHT IN E'TAH HARBOR

These small members of the auk family are about the size of our starling. One egg is laid, usually on the steep talus slope of a mountain at the edge of the sea. Frequently the birds gather like great floating islands on the surface of the water. The vast numbers of these flocks on the mountain side attract the blue fox, who, like the Eskimo, not only feasts while the birds are at hand, but also lays by a store for winter use.



Photograph by Donald B. MacMillan

CATCHING LITTLE AUKS WITH A DIP NET

An Eskimo woman will average one bird a minute, sometimes capturing as many as five with a single sweep of the net (see text, page 721).

shorter and each night a little longer, and finally the day arrived, October 25, when it bade us good-bye for 117 days, not to return until February 18, 1924. The high hills which bordered our harbor had cut off the sun's rays for two weeks prior to this day, so that our sunless period was really of 132 days' duration.

Contrary to popular opinion, we did not experience continuous darkness in the Arctic from the date of the sun's departure until its return in the spring. Our nights were dark throughout this period, as they are in the United States, but our days at Refuge Harbor were twilight during the whole time.

SNOW BLANKET MAKES THE "BOWDOIN" SNUG

Looking ahead to temperatures of 50° and 60° below zero, we surrounded our little ship with a wall of snow about three feet in thickness and reaching to the rail.

Three snow houses were built on deck, one over my after-cabin, one over the main hatch, by which the boys reached the forecastle, and one over the forward hatch, to be used as a ventilating shaft for the crew's quarters (see illustration, page 691).

Previous Arctic expeditions have been seriously inconvenienced by the accumulation of ice on the walls of the cabins, formed by condensation of the breath and of steam from the cooking. The *Bowdoin*, especially built for Arctic work, with a double inside sheathing, was remarkably free from this trouble. On the *Roosevelt*, of the Peary Polar Expedition, bedclothes and books even froze to the walls, and frequently we were compelled to chop ice from our cabin floors, especially in my stateroom, which adjoined the cook's quarters.

The *Bowdoin* was so well protected by the wall of snow that our quarters were dry and comfortable at all times. With 12 tons of coal beneath our floor, and plenty of fuel for small oil stoves, we were very happy through the long, dark period.

RADIO CONTACTS WITH PRINCE RUPERT, B. C., ENGLAND, AND GERMANY

It has always been a question in the minds of people at home as to just how we spend our time during the Arctic night. First, let me say that the *Bowdoin*

was electrically lighted, which added much to our happiness. Second, we were provided with a good library, musical instruments, and all kinds of games, of which Mah Jong seemed to be the favorite. Third, and best of all, was our radio. Upon leaving home I had no faith in this item of our equipment, for it seemed impossible that our little 100-watt station could keep in touch with the busy world to the south, and with our homes 3,000 miles distant.

Our radio equipment included two receivers of the standard Zenith circuit type, one for the reception of amateur, ship, and commercial land station radio telegrams, as well as programs from broadcasting stations; and the other a high-wave receiver to enable us to copy news, weather forecasts, etc., from transoceanic radio telegraph stations in various parts of the world.

The performance of our radio transmitter, of the same make, was marvelous, especially in consideration of its small power—only 100 watts—as contrasted with the average broadcasting stations' power of from 1,000 to 5,000 watts. It was of the close coupled type, using 500 cycle a. c. plate supply, with one tube on either side of the cycle, and storage-battery-operated throughout. It was necessary to limit our transmitting power to 100 watts in order to conserve the fuel used in operating the generator which charged our batteries.

Our voices were not heard in the States, but we hope that this record can be established by the expedition this summer.

Thousands of people in the United States listened every Wednesday night to our friends broadcasting to us from 9XN, Chicago, and wondered if we could possibly be hearing them. We never failed to pick up that station through the months of October, November, December, and January.

We often recognized the voices of our friends. On several occasions I heard my sister's voice distinctly. On several Sunday nights we heard ministers reading the Bible, uttering their prayers, preaching their sermons, and choirs singing hymns.

The four stations most consistently heard were Calgary, Canada; 9XN, Chi-



Photograph by Donald B. MacMillan

ALNAY-AH STARTING FOR AUKS: ÉTAH

Her 12-foot pole terminates in a wide dip net, with which she sweeps the air expertly for the little auks, or dovebies, known to Cape Cod fishermen as "pine knots." Their chief enemy is the glaucous gull, which often seizes an auk in mid-air and swallows it whole into the lower throat.

cago; WOC, Davenport, Iowa; and WOAW, Omaha, Nebraska.

We sent out to the world 32,000 words in telegraphic code, received chiefly by 9BP, Jack Barnsley, Prince Rupert, B. C. We received 100,000 words by code from the boys of the American Radio Relay League, from Leafield, England, and from POZ, Nauen, Germany. Every evening at 5 o'clock we picked up the English station, and promptly at 6 p. m. the German station, giving us the news of the world.

My operator, with the typewriter in front of him and phones on his ears, typed the news, and every night as we went forward to our supper under the snow, there, on the dining table, lay the daily news sheet. This served to break the monotony of the dark period and was eagerly welcomed by each member of the expedition.

On Christmas and New Year's we received many messages from our relatives and friends at home, including the following greeting:

"Even in its days of deepest distress the Greely Expedition made Christmas a day of rejoicing and praise. Our most earnest desire was knowledge of the

health and happiness of the dearest ones at home. Science and circumstances spare you such doubts. The National Geographic Society sends this Christmas message of good cheer to all members of the MacMillan Expedition, with its assurance that their health and success are dear to our hearts. Happy New Year.

"A. W. GREELY."

DAILY EXERCISE—WALKING, SNOWSHOEING AND SKIING

Because of our meteorological observations for the United States Government, and our magnetic work for the Department of Terrestrial Magnetism, Carnegie Institution of Washington, D. C., we were regular in our habits, having breakfast at 9, dinner at 3, and supper at 8 in the evening.

Nearly every man took exercise regularly, walking on bright moonlight nights far from the ship, repairing our snow wall, shoveling snow from the entrances, tending and feeding the dogs, snowshoeing, and skiing. The boys generally retired at midnight, to be called promptly at 8:30 in the morning.

Much has been said concerning this depressing period of darkness. Very little,



A BOATLOAD OF 4,000 EIDER DUCK EGGS

Both the explorers and the natives prize this addition to the winter's food supply.



Photographs by Donald B. MacMillan

YOUNG EIDER DUCKS IN THEIR NEST AT LITTLETON ISLAND IN MID-JULY

The northern eider breeds on the islands of the Greenland and Ellesmere Island coasts. Four thousand eggs may often be gathered from one small island in a few hours. The beautiful king eider arrives at Etah in May with the northern eider and frequents the same coasts.



Photograph by Donald B. MacMillan

A WATERFALL IN NORTH GREENLAND NEAR PORT FOULKE

In summer the musical sound of falling water greets the ear all along the west coast of Greenland.



Photograph by Donald B. MacMillan

SEA BATHING 12 DEGREES FROM THE NORTH POLE: ETAH

Etah, the most northern settlement in the world, consists of only five black holes in a sloping hillside, and in some years these are not inhabited. The cliffs of its beautiful harbor rise 1,100 feet from the water's edge. It is here that the MacMillan Expedition of 1925, under the auspices of the National Geographic Society, will establish its main base (see text, page 673).

however, has been written about the long moonlight periods of each month, when the moon comes above the horizon and remains there continuously. It swung around in a great circle over our heads, about ten days each month, and turned the region into a veritable fairyland.

During these wonderful times, we traveled hundreds of miles with our dogs to visit the Eskimos in their homes to the south, where we always found much of interest in the study of their domestic life.

The nearest village was Nerky, 60 miles by sledge route to the south on Ingfield Bay. To reach it we had to sledge over the sea ice, closely following the land to Cape Alexander. Here we crossed a tongue of the Great Mer de Glace and went galloping along the shore to Peteravik, and then on down past the face of another glacier. There were many exciting experiences in working on slippery ice slopes, where a drop into the sea would mean death.

As soon as the Eskimos learned that we were in winter quarters at Refuge Harbor, visitors were coming and going throughout the winter. All were eager to hear the strange voices coming through the air, and to see our 20,000 feet of motion pictures, which brought forth many an "Ooh" and "Ah" at the wonders of civilized life.

BRONZE TABLET OF THE NATIONAL GEOGRAPHIC SOCIETY IS ERECTED

Since we had failed the preceding summer to reach Cape Sabine, 30 miles to the northwest, on the shore of Ellesmere Island, our first duty in the spring was to carry out the request of the National Geographic Society—to place its bronze memorial in the center of the Greely Camp.

Early in May I left the ship, accompanied by my faithful dog-driver, E-took-a-shoo; his brother, Ka-ko-tchee-ah, and my Labrador boy, Abram Broomfield, on

a reconnaissance to examine the condition of the ice of Smith Sound, and to select a suitable place for the tablet.

We crossed the Sound in seven hours, and reached the site of the Greely Camp in a blinding snowstorm. The remains of the rock hut could still be seen projecting from the snow.

Walking through the little valley to Cemetery Ridge, where many of the bodies were found by the relief party in the spring of 1884, we came upon the ring of rocks which had held down the tent of the starving men. A bare spot in this vicinity was still littered with the remains of their camp.

Stretching southward from the cape to the very horizon was a large body of water, which always buoyed the men of the Greely party with the hope that a ship might reach them at any time during the fall and spring.

A return trip of eight hours brought us back to our ship at Refuge Harbor. Our time spent in crossing the Sound with dog teams is of especial interest, since the party of Dr. Isaac Israel Hayes in 1861 consumed about 31 days in passing from shore to shore. Had the Greely party been equipped with dogs and some reliable Eskimos, all might possibly have crossed to Greenland successfully and been saved by living with the natives.

A few weeks later we crossed again with four dog teams. The tablet was landed in the center of the camp, where we bolted it securely to a 100-ton boulder.

The work completed, we covered it with the American flag. The next day we unveiled it in the presence of the Eskimos, and told them to inform their children that the tablet must remain forever, in honor of the white men who died there so many years ago. They seemed to understand the object of our visit and the purpose of the tablet, and promised me they would always protect it (see illustrations, pages 700 and 706).

IN SEARCH OF THE MUSK OX

A few weeks later we left the ship again, our objective being Eureka Sound, some 200 miles to the west, in search of that strange and most interesting animal of the Far North, the musk ox, more nearly allied to the buffalo than any other

living animal. It is of interest to scientists to know that the range of this animal extends to the very edge of the Polar Sea, just as far north as land goes, where it lives during the darkness of the long night upon wind-swept areas covered with frozen grass and moss.

Upon our visit to Cape Morris Jesup, the northernmost point of land in the world, distant 380 nautical miles from the North Pole, we found great herds of these animals roaming the hills; in fact, they range all through northern Greenland, Grant Land, and Axel Heiberg Island. Their enemy is the white wolf, whose tracks are seen wherever musk oxen are found.

After struggling with deep snow and reaching Victoria Head with considerable difficulty, we emerged upon the smooth ice fields of Flagler Fiord, over which we galloped merrily toward the pass leading between the high mountains of Ellesmere Island to Bay Fiord.

As we proceeded through the valley of Ellesmere Island's western shores, we encountered a huge glacier coming down between the mountains at right angles to the course of the valley and blocking it almost completely. E-took-a-shoo and Ka-ko-tchee-ah, who had passed through the valley in 1910 and 1911, were astounded at the rapid advance of the glacier, which agrees with our observations of every other glacier from 76° N. to the edge of the Polar Sea.

With difficulty we succeeded in squeezing between the face of the glacier and the slope of the hills. Great blocks of ice, continually falling from the face of the glacier into the narrow pass, so terrified the Eskimos that twice they abandoned their dogs and sledges and scrambled up the side of the mountain.

At the other end of the glacier we lowered the sledges with ropes, harnessed the dogs, and, with a sigh of relief, drove westward. We all vowed never again to attempt the pass, but to proceed home over the Ellesmere Island ice cap, at a height of 4,000 feet, rather than tempt fate.

We emerged upon the slippery ice of Bay Fiord in a gale of such violence that our dogs and sledges were repeatedly blown sideways for hundreds of yards at



Photograph by Donald B. MacMillan

AN ESKIMO GIRL AT HOLSTENSBORG, GREENLAND

She wears over her shoulders an elaborate homemade collar of open beadwork. Her blouse is of brightly striped, imported material and her trousers of hairy sealskin. Her red-and-white boots are also of sealskin, with the hair removed, and decorated at the top with geometrical patterns of colored skin. Holstenborg, a picturesque town just above the Arctic Circle, overlooks a fine harbor. Its four or five Danish houses occupy a common inclosure, to the west of which live the Eskimos. The entire population numbers 300.



Photograph by Donald B. MacMillan

MIDSUMMER: THE SCHOONER "BOWDOIN" IN REFUGE HARBOR, GREENLAND, JULY 1, 1924

In a good harbor there is no danger of a ship being crushed by the ice, provided it is not in a tidal crack—a gigantic mouth which opens, shuts, and grinds continuously. The *Bowdoin* made an attempt to leave the Refuge Harbor of Kane on July 29, but did not get clear of rocks and ice until August 1.



Photograph by Donald B. MacMillan

THE "BOWDOIN" CLAD IN WINTER ICE: REFUGE HARBOR, APRIL 10, 1924

Note the three snow houses built on the deck and the ship's warm blanket of snow on the sides. The ice barrel (lookout) is to be seen aloft, just below the wireless rigging. Most of the radio messages from the *Bowdoin* were received last year on the Pacific coast. The Eskimos were eager listeners to the strange voices coming through the air from America, England, and Germany. They were frequently entertained on board ship during the winter.



Photograph by Donald B. MacMillan

COMING : SOUTHWARD BOUND FROM CAPE HATHERTON, A FEW MILES NORTH OF ETAH

Dog-drawn sledges are the only means of transport and travel along the west coast of Greenland north of the Arctic Circle, when ice in the sea prevents the use of the kayak (see page 698). Each sledge is drawn by a team of from eight to fourteen dogs, who spread out like a fan.



Photograph by Donald B. MacMillan

GOING : SLEDGING ALONG THE BROAD, LEVEL ICE FOOT NORTH OF RENSSELAER BAY

Ninety miles north of Etah is Rensselaer Bay, the winter quarters of Dr. Elisha Kent Kane in 1853-55. Sandstone mountains stand on both sides of the bay, in contrast with the rounded granite hills of the adjacent country.



Photograph by Donald B. MacMillan

THE AUTHOR MAKES FRIENDS WITH A YOUNG MUSK OX

When convinced that no harm was intended, this calf speedily became friendly. At the time of its capture it struggled fiercely, repeatedly jumping high in the air and coming down on its back. This is its instinctive mode of crushing the white wolf, the vicious enemy of the musk ox.



Photograph by Donald B. MacMillan

MUSK OXEN READY FOR THE FRAY: BAY FIORD, ELLESMERE ISLAND

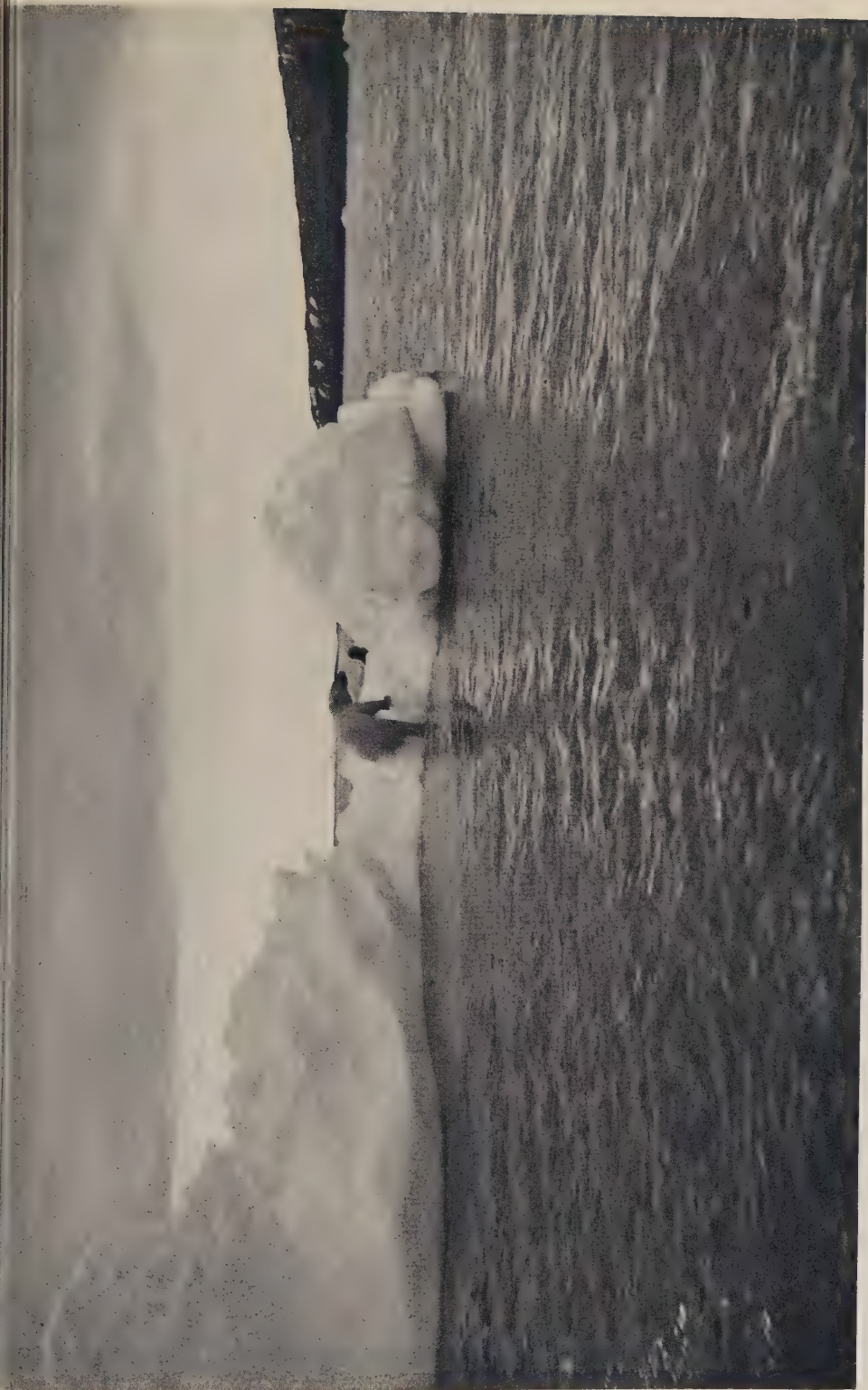
When at bay, the herd is a huddled, formless mass. All the animals, even the calves, face the enemy, but the little ones hide beneath their mothers' long, shaggy hair. The oxen charge with their heads close to the ground, and without order, but retreat at once to the herd, for fear of being cut off and surrounded. The author obtained the first motion pictures ever made of musk oxen. The Eskimos call Ellesmere Island *Oo-ming-man*, the Land of the Musk Oxen.



Photograph by Donald B. MacMillan

AN ICEBERG IN ETAH HARBOR

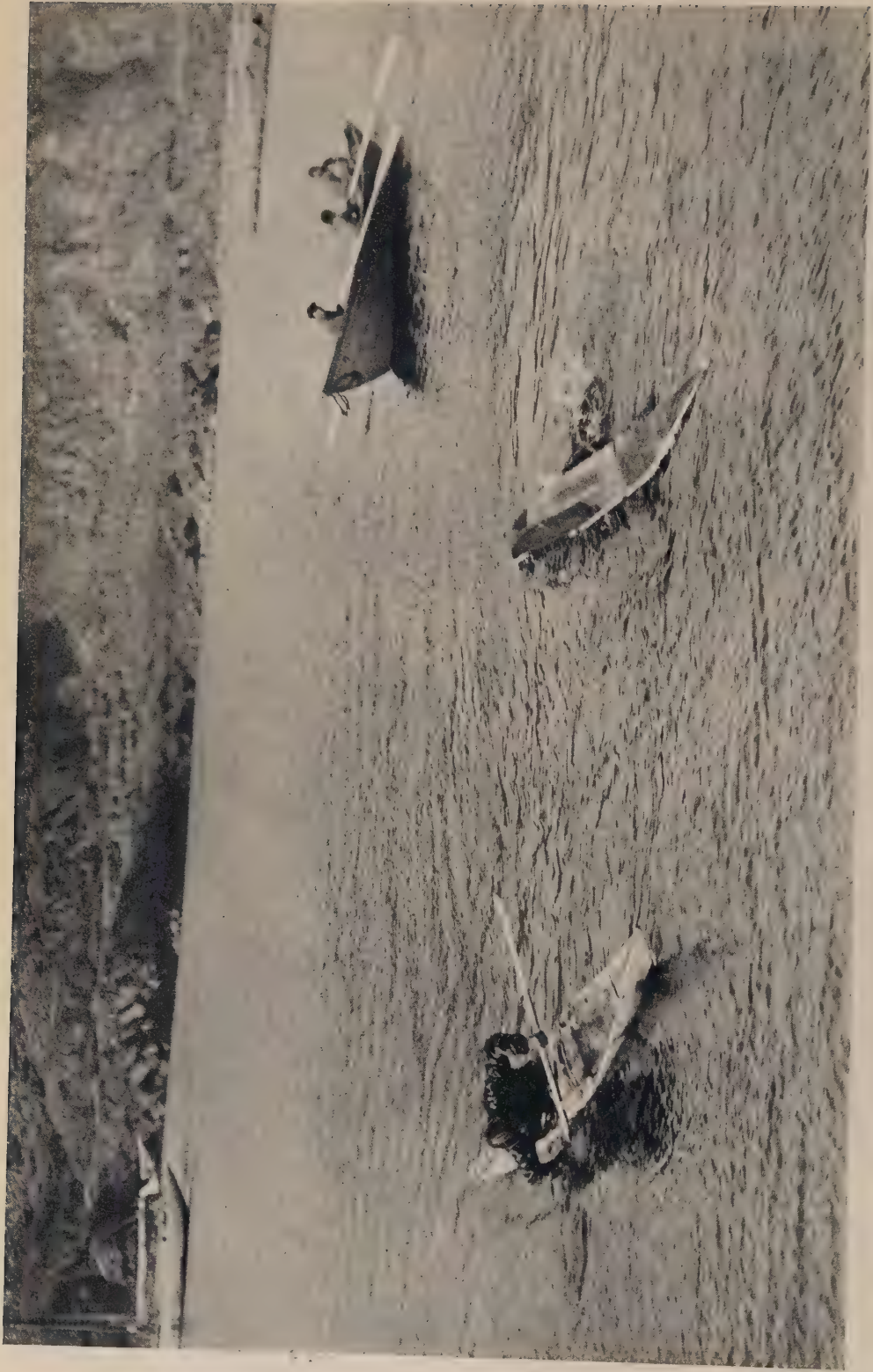
This white mountain arrived at Etah and remained in sight of the author's headquarters for two years. Note the arch, which occurs not uncommonly in large bergs.



Photograph by Donald B. MacMillan

"THE TIGER OF THE NORTH" ASCENDING A BERG IN E TAH HARBOR

The Eskimo finds his greatest pleasure in running across fresh bear tracks and being ahead of all his companions in pursuit. The skin of the polar bear is considered indispensable for trousers, without the warmth of which long journeys in the winter time would be impossible. It is also used as a bunk rug. The "water bear" of sailors is amphibious, being more at home in the water than on the ice fields. It has been reported swimming 100 miles from land.



Photograph by Donald B. MacMillan

KAYAK MANEUVERS IN HOLSTENSBORG HARBOR, GREENLAND

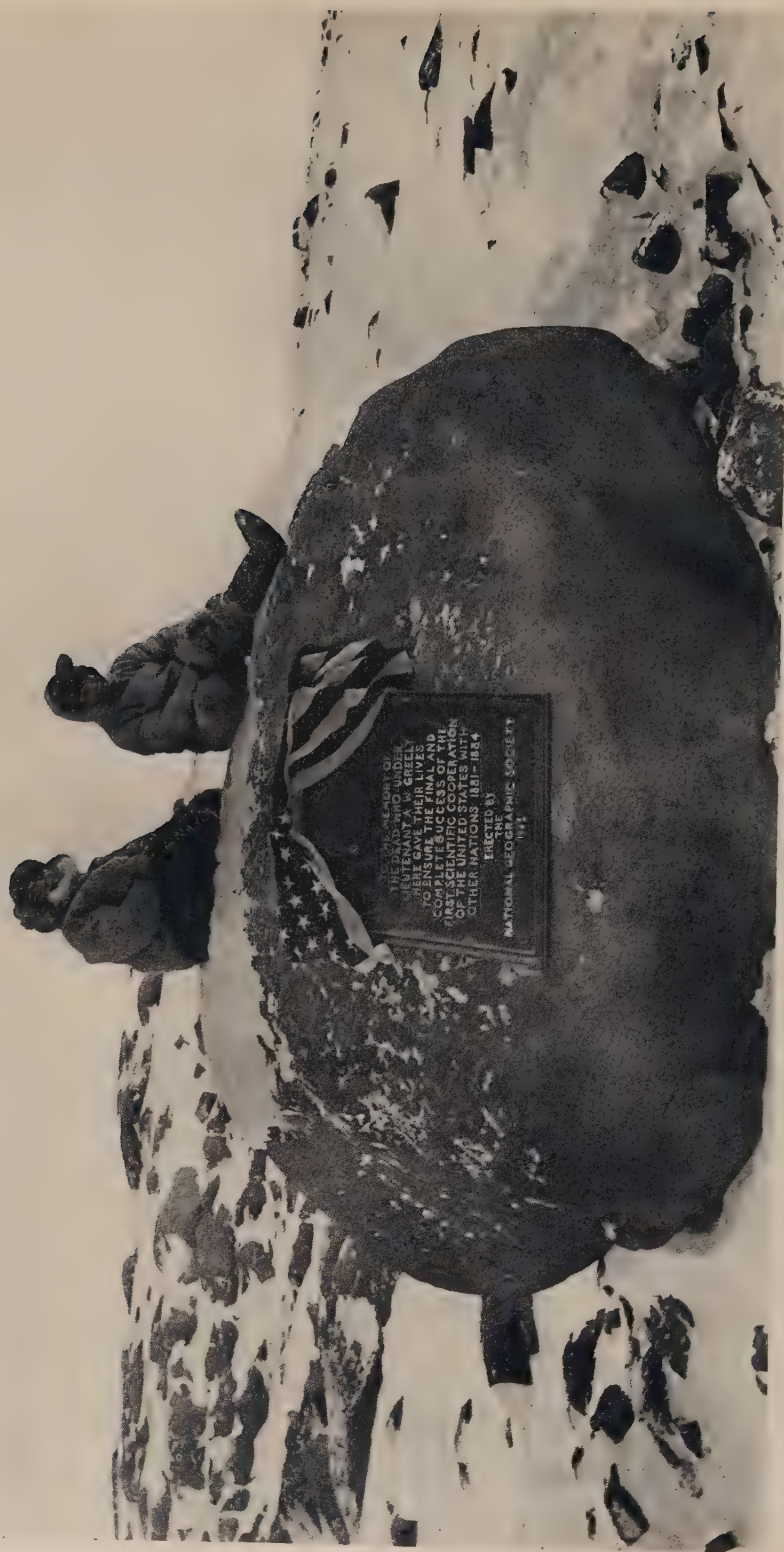
The long, narrow boat of the most expert boatmen in the world has been aptly termed "the most perfect application of art and ingenuity to the pursuit of necessities of life within the Arctic Circle." The ability of the Greenlander (as the Eskimo likes to be called) to roll over in his kayak, to hang head-down in the water, and even to spin over and over, as the man in the kayak on the right is doing, affords a unique exhibition of skill. The one-man craft is about 16 feet long, with a beam amidships of 6 feet.



Photograph by Donald B. MacMillan

ESKIMO CHILDREN PLAYING "CAPTURING A WALRUS"

Smith Sound Eskimos gather every spring at Peteravik (Cape Chalon), some 25 miles south of Etah, to hunt walrus and bearded seal in the open water offshore. The tribe makes the annual meeting a picnic occasion, when warriors tell stories of the hunt and laughing children play games. The boys are wearing bearskin trousers and the girls long sealskin boots.



Photograph by Donald B. MacMillan
 TO THE HEROIC DEAD OF THE GREELY EXPEDITION : CAPE SABINE,
 ELLESMERE ISLAND

THE NATIONAL GEOGRAPHIC SOCIETY'S MEMORIAL TABLET TO THE HEROIC DEAD OF THE GREELY EXPEDITION : CAPE SABINE, ELLESMERE ISLAND

After crossing Smith Sound, the MacMillan party landed the bronze tablet in the center of Greely's former camp and bolted it securely to a 100-ton boulder. "The work completed, we covered it with the American flag. The next day we unveiled it in the presence of the Eskimoes and told them their should inform their children that the men who gave their lives for the United States were the first to die in the Arctic." The tablet is inscribed with the following text:

IN THE MEMORY OF
 THE MEN WHO GAVE
 THEIR LIVES TO
 SECURE THE FINAL
 AND COMPLETE
 FIRST SCIENTIFIC COOPERATION
 OF THE UNITED STATES WITH
 OTHER NATIONS (1881-1884)
 ELLESMERE ISLAND
 NATIONAL GEOGRAPHIC SOCIETY
 1914



Photograph by Donald B. MacMillan

THE MIDNIGHT SUN FROM SUNRISE POINT, LOOKING NORTH OVER LITTLETON ISLAND

Eight exposures were taken on the same photographic plate at 20-minute intervals. Sunrise Point was named by the Hayes Expedition, which found it a favorable spot to observe the first rising of the sun after their memorable winter. Littleton Island is famous in Smith Sound history. Though named by an Englishman, an American explorer, Dr. Elisha Kent Kane, was the first to step upon the island and to unfurl the American flag over it 72 years ago.



Photograph by Donald B. MacMillan

SONNTAG BAY AND GEORGE W. CHILDS GLACIER, SOUTH OF CAPE ALEXANDER

This bay is named for the astronomer of both the Kane and Hayes expeditions (1853-55 and 1860-61, respectively). Cape Alexander is midway between the Arctic Circle and the North Pole.



Photograph by Donald B. MacMillan

ROUGH SLEDGING ALONG THE FACE OF REID GLACIER

The condition of the sledging surface is the main factor in estimating the load of a team. For the average sledging surface met with on a long spring trip, 80 pounds to each dog is a good load. But the strength of the driver—who must often struggle to save the sledge from destruction—the qualities of the sledge itself, and the distance to be traversed are also to be considered.

a time. It was a fight to regain the north side of the fiord, where we planned to camp for the night.

THE EXCITING CAPTURE OF AN ARCTIC WOLF

The next morning our dogs galloped westward before a strong wind to a better sledging surface lightly covered with snow, upon which we discovered many fresh tracks of polar bear. During the next few hours we had many a mad race following these trails, the dogs being much excited.

Nothing happened, however, until about noon, when one of the men looked back over his shoulder and descried in the distance an animal following our trail. It proved to be an enormous snow-white wolf. As there is only one specimen of this animal in any museum of the world, I was anxious to add it to our trophies.

Since wolves are wary—in fact, the most difficult animals in the North to bag—it was a problem how to accomplish our purpose. As we lived largely on the country during our spring trips, we were always equipped with a seal screen, used in stalking seals sunning themselves on the ice. I suggested to Ka-ko-tchee-ah that we place the screen in the middle of the trail, that he crouch behind it with loaded rifle, there to await the wolf while we drove on (see page 708).

The ruse worked to perfection. When we halted our teams, the wolf squatted on his haunches about a quarter of a mile away, but when he saw us drive down the fiord, he immediately jumped to his feet and followed, walking deliberately up to the screen, probably mistaking it for one of the many hummocks of ice dotting the surface.

When the animal was within 20 yards, the boy fired. The wolf wheeled, bit savagely at one of his hind quarters, and leaped backward along the trail. The boy fired again. The wolf rolled completely over, jumped to his feet, and again started off. At 50 yards he dropped. I immediately sent back Koo-e-tig-e-to with a dog team to bring up the kill.

When the two boys rejoined us, I was astounded at the vitality of the animal, for the first shot had laid bare the heart and liver and should have killed it instantly. My measurements showed that

it was 6 inches higher at the shoulder and 6 inches longer than our largest dog, and weighed at least 125 pounds (see page 710).

While we were examining the wolf an exclamation of "Ta-Koo!", by E-took-a-shoo, called our attention to a herd of 15 musk oxen grazing upon a bare patch of grass about half a mile up a small valley leading from the sea ice. We immediately headed for the nearest point of land, and there pitched camp to await a more favorable light for obtaining a series of motion pictures.

This was the real object of the western expedition. Hitherto no one had ever obtained motion pictures of this strange animal, which scientists claim has come down to us from a period of 500,000 years ago.

The next noon the sun shone brightly, offering a favorable opportunity for our work. With empty sledges we proceeded cautiously up the valley to the spot where the animals were seen the day before, but they were gone.

E-TOOK-A-SHOO TRACKS A HERD OF MUSK OXEN

E-took-a-shoo immediately quartered the ground in every direction with his sharp eyes and examined every track, and in a few moments announced that the animals had gone over the tops of the highest hills to the west.

Not a track could be seen, and it was with reluctance that the two Eskimo boys and I consented to follow him.

After traveling an hour we ascended a high hill and E-took-a-shoo called for binoculars. After scrutinizing the land to the west, he declared that he could see the whole herd sleeping quietly on the top of a distant hill.

Upon reaching the base of the hill, where the animals were sleeping, we tethered some of our dogs to huge bowlders, knowing that, when the fight began, they would do their utmost to break from their harnesses.

It was necessary to have the aid of a few dogs to hold the musk oxen at bay while they were being photographed. Since these animals charge with great rapidity, we selected five of the most active dogs—those thought capable of avoiding sharp horns.



Photograph by Donald B. MacMillan

THE GREELY TABLET BEFORE UNVEILING: CAPE SABINE (SEE ALSO PAGE 700)

This memorial to one of the most tragic chapters in the history of American Arctic exploration is more than 700 miles above the Arctic Circle and is, therefore, one of the most northerly monuments in the world to heroism and to international scientific cooperation. One of Peary's huts is also on Cape Sabine.

On reaching the crest of the hill, the huge beasts were in full view. We released the dogs from their traces, and they shot away at full speed. We, in contrast, seemed to plod at a snail's pace, carrying the heavy motion-picture camera and the extra magazines.

The great, shaggy, black masses instantly jumped to their feet and formed a circle, heads out, tails in, and horns lowered (see pages 695 and 711).

When I arrived, I noticed that nearly all of the animals facing us were rubbing the sides of their heads between their forelegs. They had never seen dogs or men, and probably thought we were a band of wolves. In fact, a white wolf seated on a neighboring mound was an interested spectator of the whole ensuing performance.

When attacking musk oxen in 1909 on the northern end of Greenland, I noticed that, upon our approach to the herd, the bulls repeatedly dropped their heads and scraped the ends of their horns upon a boulder in their midst, as if sharpening

them for an attack. But the practice of rubbing their heads on their legs puzzled me for some moments, until I concluded that they were rubbing away the frost formed about their eyes by the condensation of their breath in cold weather. They were thus able to see their assailants more clearly.

THE AUTHOR MAKES THE FIRST MOTION PICTURES OF MUSK OXEN

In several books on the Arctic, I have found elaborate accounts of how musk oxen exhibit the intelligence of a well-trained company of soldiers, forming into a perfect hollow square and charging in turn into the enemy. My motion pictures show that they are simply a huddled mass without formation. They charge without order, but always retreat immediately to the herd, as if fearful of being cut off and surrounded by the enemy.

Mothers and calves are not in the center, protected by an encircling line of bulls. All, even the little ones, face toward the point of attack. The very



Photograph by Donald B. MacMillan

NORTHLAND ANIMALS AND BIRDS, DRAWN BY A SMITH SOUND NATIVE

The artist, old Pan-ik-pah, was employed by Peary practically from the beginning of his work in Greenland, in 1891, until his discovery of the North Pole, in 1909. He is now 63 years old and is still active.

young, however, repeatedly hide beneath the bellies of the mothers, being almost completely concealed by the latter's long, shaggy hair, which reaches nearly to the ground (see, also, page 695).

A musk ox will charge with its head very close to the ground, catch a dog on its horns with a vicious thrust, and rip him completely open. I have also seen some toss dogs into the air and crush them flat with their big heads when they strike the ground. A dog, however, is rarely caught unless hampered by the musk ox treading upon his trace as he endeavors to get away.

Musk oxen are covered with a coat of

wool and long hair, which must furnish perfect protection even in temperatures as low as 75° below zero. They feed upon wind-swept patches of grass during the winter months, and, when all grass and moss are cropped, they wend their way through deep snow to other favorite feeding grounds. I have found them seeking food in snow a foot deep, pawing it away with their hoofs and removing it with their noses.

All seem to keep in fine condition, even in severest weather. We have killed them in temperatures as low as 50° below zero and found their paunches filled with great masses of frozen grass.



A SEAL SCREEN, WITH KOO-E-TIG-E-TO BEHIND IT, ON THE ICE (SEE TEXT, PAGE 705)



Photographs by Donald B. MacMillan

A FRONT VIEW OF THE SEAL SCREEN

Though the Eskimo is adept at hunting with his own weapons, it was Peary who gave them effective equipment for winning their livelihood more easily.

Incidentally, musk-ox meat is considered to be the most delicious in the Far North. It tastes a bit like good beef, and, in the opinion of some, like mutton. Apparently as large as a good-sized buffalo, the animal is pitifully small when the shaggy coat is removed.

PAINFUL SLEDGING OVER THE ICE CAP

The Eskimos, having no desire to repeat their experience undergone between the face of the glacier and the mountain, eagerly adopted my suggestion for a return trip over the top of the ice cap of Ellesmere Island, a route taken by us in 1914 and '16.

We soon encountered snow of such depth that we were compelled to exchange all of our fur clothes for woolens, the heat from our exertions in lifting and pushing the sledges being almost unbearable.

Covered with perspiration and with underclothes wringing wet, we toiled painfully through the valleys and up over the high hills.

We plodded on and upward for three days, hoping to find better conditions. Dogs and men were exhausted at the end of each day.

Finally we encountered one steep snow-covered hill, which stopped the two younger boys completely. E-took-a-shoo and I, having better dogs, succeeded in reaching the summit, and wondered if the others could possibly make it.

These primitive men, without books, schools, or written language, are fully as resourceful as the white man. They will



Photograph by Donald B. MacMillan

A WHITE WOLF SHOT IN EUREKA SOUND

Only a few specimens of this species are to be found in museums of the world (see text, page 705).

generally get out of a difficulty. I could hear the boys yelling at their dogs and snapping their long rawhide whips, before their heads appeared over the summit of a distant rise.

They had harnessed all their dogs to one sledge. Koo-e-tig-e-to was driving and Ka-ko-tchee-ah was walking immediately in front of the dogs, encouraging them by dragging under their noses a big piece of meat on the end of a string! Puffing and perspiring freely, they reached the top of the hill.

The next day we encountered even worse sledging conditions. Thoroughly disgusted with our new route, we decided to give it up, count our three days' work



KOO-E-TIG-E-TO AND A DEAD WHITE WOLF, WITH THE ESKIMO DOG "GRANT"



Photographs by Donald B. MacMillan

E-TOOK-A-SHOO AND KOO-E-TIG-E-TO SKINNING A WOLF: BAY FIORD

This wolf, shot by means of the seal screen (see illustrations, page 708, and text, page 705), was larger than a good-sized dog. The white wolf is more enduring, has a wider range, and passes an easier existence than any other Arctic animal. It infests Axel Heiberg Island, where its tracks mingle with those of musk oxen and caribou.



Photograph by Donald B. MacMillan

MUSK OXEN OF BAY FIORD FACE THE DOGS AND CAMERA (SEE, ALSO, ILLUSTRATIONS, PAGES 694 AND 695)

The meat of these remarkable animals, which keep in good condition throughout the severe winter weather, has been compared to beef and sometimes to mutton. Note the calf huddled against its protecting elders.

as wasted, return to the head of Bay Fiord, and go home by the old route, in spite of the danger of falling ice.

THE ESKIMO DOG OF THE FAR NORTH FEARS THE WATER

The following two days are memorable. I have never known my men to be so completely exhausted on any of our spring trips. The warm sun of the past few days had converted every compacted snow bank into a mushy mess and removed every vestige of snow from the river bed leading back to the face of the glacier. Not only did bare ground hinder progress, but the water in the river bed was at times over the slats of our sledges. We were compelled to unlash, unload, and carry everything on our backs for miles.

The Eskimo dog of the Far North is mortally afraid of water, and only under the stinging lash of the long whip will he consent to wade through it, especially in low temperatures.

Cutting holes for our toes so that we would not slip, we laboriously worked the teams up the face of the glacier, thence along the bottom of the ice-covered ravine, between the face of the ice and the

mountain. From there on, it was a struggle to drive our sledges through the grit and gravel of the hills to the sea ice at the head of Flagler Fiord.

Our nicely polished runners were scarred deep by the rocks, and the soles were ripped from our boots.

With genuine expressions of relief we drove on to the hard ice of the fiord. We had not only left land and rocks behind, but were now in touch with seals sunning themselves on the surface of the ice. Our dogs had not been fed for five days.

Within an hour E-took-a-shoo killed two seals, and our dogs were filled to the neck. In the warm sunlight we sat contentedly round the boiling pot filled with hearts, livers, and tenderloins. At such times hardships of the past are soon forgotten, and pleasures of the long trail accentuated.

Upon reaching the mouth of Flagler Fiord, we were astounded to see a great expanse of open water, an unusual condition at that time of year. It compelled us to travel on the ice foot close to the land, watching for an opportunity to cross to the solid ice of Buchanan Bay.

Our disappointment was somewhat



A YOUNG MUSK OX TIED TO E-TOOK-A-SHOO'S SLEDGE

MacMillan pays to this native dog driver, who has served with him on several expeditions, the tribute "the best Eskimo I have ever employed."

Photograph by Donald B. MacMillan



Photograph by Donald B. MacMillan

CONFRONTED BY REID GLACIER ON THE MUSK OX TRIP TO EUREKA SOUND



Photograph by Donald B. MacMillan

ROUGH ICE IN THE POLAR BASIN 100 MILES NORTHWEST OF AXEL, HEIBERG ISLAND

This illustration provides one answer to the question why it took man more than 300 years to reach Farthest North.



Photograph by Donald B. MacMillan

THE SUMMER HOME OF A SMITH SOUND ESKIMO FAMILY: NERKY

The sealskin *tupik* is well built and is ideally shaped to resist gales from the big hills. The covering is braced by numerous poles and held down on the outside by a ring of heavy stones. Nerky (Meat) is an Eskimo settlement 60 miles by sledge south of Etah (see text, page 687).



Photograph by Donald B. MacMillan

PEEPING FROM HER TUPIK (SEE, ALSO, PAGE 715)

Ringed and bearded seals, besides furnishing this tent material, are useful in other ways. The skin of the ringed seal makes summer coats and boots; the tough skin of the bearded, or thong, seal makes an excellent sole for the *kamik*, the boot of the Smith Sound native. The meat of the seal is "the Eskimo's turkey, his staple food; a seal's flipper is his entrée, and a frozen seal's liver his ice cream." The skin tupik of summer gives way in winter to an igloo built of stone, and in the spring, or when traveling, to one of cut blocks of snow.

relieved by the first real signs of spring. The water was dotted with long-tailed and eider ducks, sea pigeons, and glaucous gulls.

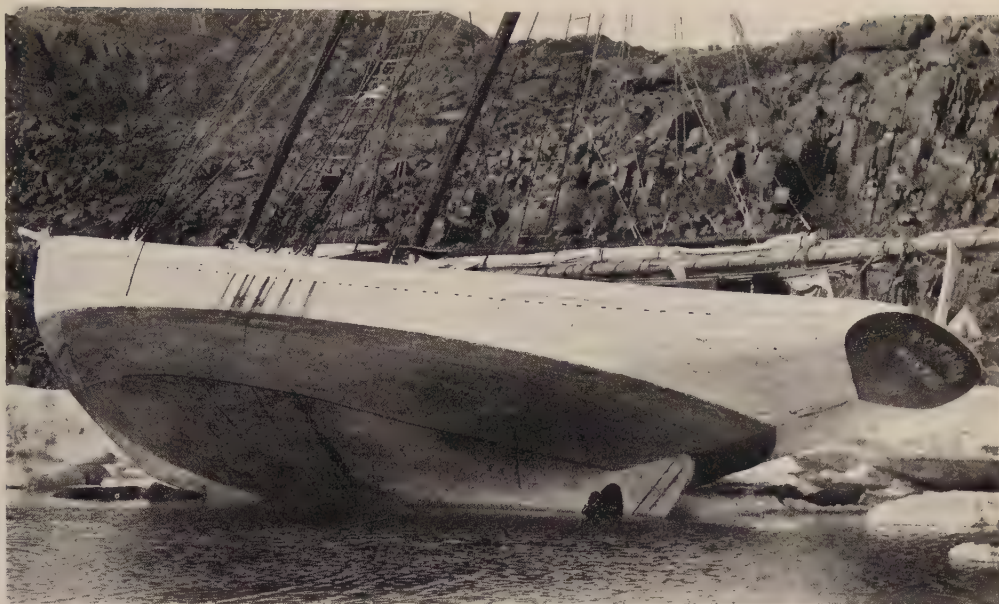
EIGHTY MILES ACROSS HARD, BLUE ICE

Making a bridge out of ice cakes brought to us by the incoming tide, we succeeded in reaching the bay ice, which stretched continuously for some 80 miles to the little *Bowdoin*, in Refuge Harbor. Once through the deep snows of Buchanan Bay, we drove rapidly over the

hard, blue ice of Smith Sound, reaching Point Cairn, half a mile from the ship, at midnight on June 1.

Here again we were delayed by open water caused by tides swirling out of Kane Basin.

Leaving our sledges on the ice foot on the back side of the point, and leading our tired dogs, we ascended the rocky hills surrounding the harbor. Upon reaching the familiar ice point 500 feet above the ship, the dogs wagged their tails and bounded away.



IN A PRECARIOUS POSITION: REFUGE HARBOR

In attempting to leave the harbor, the *Bowdoin* ran upon a pinnacle of rock at high tide. Realizing that at low water the ship would fall upon its side and possibly fill, an attempt was made to keep it upon even keel by running masthead lines to cliffs on the starboard side and to anchors imbedded in the ice on the port side (see text, page 720).



Photographs by Donald B. MacMillan

THE "BOWDOIN'S" RAIL LEVEL WITH THE WATER: REFUGE HARBOR

When some of the ropes snapped, the vessel keeled to port and water poured over the rail. After relieving the ship of all possible weight, the members of the expedition pulled it over on the starboard side and finally succeeded in floating it (see text, page 721).



Photograph by Donald B. MacMillan

ME-GISH-OO (SEE, ALSO, PAGE 676) AND SHOO-E-GING-WA ARE PLAYING WITH PUPPIES ON FATHER'S BIG BEARSKIN

The full-blooded Eskimo dog is one of the most affectionate of pets.

The ship at this time presented a welcome picture to us. The three snow houses upon her decks had melted away, the protecting snow wall had fallen down—summer had come.

Every good day was now utilized in hunting seal and walrus, and in packing away meat for the following winter, since there was always a possibility that our harbor would not melt out and that the ship might be detained for a second year. Trips were planned to Littleton Island, 15 miles to the south, where we often

picked up 4,000 fresh eider ducks' eggs in three hours (see page 685).

Some 36 kinds of birds return to the Far North in the middle of May, and leave the latter part of September. They furnished us with an abundance of food.

In July all southern slopes were green with grass and covered with flowers. It is not generally known that, in this land supposed to be continually covered with ice and snow, botanists have collected more than 700 different kinds of flowers. In fact, flowers are found just as far



GATHERING FLOWERS AT FOULKE FIORD, 700 MILES FROM THE NORTH POLE



Photographs by Donald B. MacMillan

THE COMMONEST FLOWER OF THE NORTHLAND

The starry blossom of *Dryas integrifolia*, of the rose family, is found almost everywhere in the Far North during the summer. It is white, with a yellow center.



Photograph by Donald B. MacMillan

TAH-TAH-RAH TAKES AN ARCTIC SUN BATH

This "costume" is not uncomfortable for Smith Sound children in August.

north as land goes—380 miles from the North Pole.

THE SHIP IS FREED FROM A 330-DAY IMPRISONMENT IN THE ICE

On July 29, we hoisted our flags and decided to make an attempt to break through the harbor ice, where we had been imprisoned for 330 days. I had carefully sounded every foot of the way and knew that the *Bowdoin*, with her 10-foot draft, could make it, if not prevented by the thickness of the ice.

Just before we started off, the wind changed directions, and the harbor ice moved some 10 to 14 feet to the north. Our channel between the ice and the land

was thus so narrowed that, upon endeavoring to round a point of ice, we touched, at about high tide, upon a pinnacle of rock.

In spite of all our efforts to dislodge the vessel with engine and strong lines, we stuck fast.

Realizing that upon dead low water the ship would fall flat on its side and probably fill, it was necessary to hold it up, if possible, upon an even keel. Therefore we ran masthead lines to the cliff on the starboard side, and to anchors imbedded in the harbor ice on the port side. We succeeded in our attempt for about five hours, at which time the *Bowdoin* seemed to be completely out of water and perched upon a rock about midship (see page 717).

Then without warning came a cracking and finally a snapping of the 'ropes leading to the cliff, and away

went the vessel down upon her port side. The water poured over the rail and splashed against the cabin house.

Everything, even two of my men, went flying off the deck and disappeared beneath the water. Considering the fact that the harbor water was three degrees below the freezing point of fresh water, the unfortunates lost no time in coming to the surface and struggling to the edge of the ice.

Realizing that the *Bowdoin* might fill on the succeeding flood tide and be lost, we relieved it of all possible weight. We dropped both anchors and 90 fathoms of chain under the bow, emptied all water tanks, and cleared the hold. As a further

precautionary measure, we screwed up, as tightly as possible, all portholes on the port side and caulked the after companion-way.

As a result of this fall, the *Bowdoin* crushed one plank on the port side.

The next day we deliberately pulled the ship over on the star-board side. This resulted in two more crushed planks, but, since the bottom was reinforced with 22 tons of cement, I knew that this injury would not materially affect the safety of our voyage home.

A MILLION-TON ICE-BERG BLOCKS THE HARBOR

On the morning of August 1 we succeeded in floating the ship and, with 15 Eskimos and 75 dogs, started for the harbor mouth.

When we were within 30 yards of the entrance a huge ice-berg, weighing perhaps 1,000,000 tons, came sailing with wind and tide and blocked the harbor completely. With a large ice-saw we worked for three hours upon a neck of ice impinging upon the berg. Then, at full speed, the *Bowdoin* bucked this neck, cracked it, and slowly worked out through the mass of drift ice beyond. At last we were free, having been prisoners since September of the preceding year.

The violence of the wind was such that we should have anchored under the first protecting cape. Glad to be out, however, we bucked at full speed into a heavy head sea for 15 miles south to Etah.



Photograph by Donald B. MacMillan

TWO YOUNG SNOW BUNTINGS TAKEN IN THEIR NEST AT REFUGE HARBOR

The little Kop-a-noo of the Eskimos nests in northern Greenland and Grant Land. It is very musical during the breeding season.

Nearly all of the Eskimos were sea-sick, with the exception of Koo-e-tig-e-to, who twisted a rope so tightly around his stomach that he could hardly breathe. Where the boy got the idea I do not know, but the drastic method proved highly efficacious.

Anchoring at Etah, we found the Eskimos busily engaged on the cliffs in netting little auks, which swarm there literally in millions. Each time a native sweeps the air with a 12-foot dip net he captures from one to five birds, which he puts into a sealskin bag. These grace many a feast during the winter, when



Photograph by Donald B. MacMillan

HARDY BLOSSOMS WITHIN 12 DEGREES OF THE NORTH POLE

This bed contains five varieties of blooms. The bright Arctic, or Iceland, poppy (*Papaver nudicaule*) is a nomad, being found everywhere in the Northland, blossoming even at the edge of the Polar Sea, at Cape Morris Jesup. Characteristic grass of the slopes where the little auk nests is the Arctic timothy or alpine foxtail (*Alopecurus alpinus*), also used by the Eskimo as boot padding, mattress, dishcloth, and towel. The Arctic arnica (*Arnica alpina*) resembles a small sunflower in habits and appearance, and the alpine everlasting (*Antennaria alpina*), its southern cousins. The rose family is also represented by the entire-leaved mountain avens (*Dryas integrifolia*; see, also, page 719).

they are eaten raw and uncleaned (see pages 680, 681, and 682).

As we proceeded south, dropping our Eskimos and their dogs at different villages, we encountered only one field of ice—in Melville Bay—which was easily negotiated.

We coasted down the Greenland shore, calling at Disko, Egedesminde, Holstenborg, and Godthaab. At the last-named post we were royally entertained. Here the Eskimos gave us a remarkable exhibition of their mastery of their kayaks, rolling over in them, hanging head-down in the water, and even spinning over and over. These men well deserve the reputation of being the most expert

boatmen in the world (see illustration, page 698).

We left Godthaab for Labrador with the Round-the-World Flyers. We came across in two and a half days; the planes flew the 560 miles from Ivigtut in about 7 hours.

Our trip from Labrador to Wiscasset, Maine, was without incident, with the exception of two gales of wind, one off Newfoundland, and the other off Halifax, Nova Scotia.

We reached Wiscasset on September 20, and were greeted by 6,000 people who had gathered from all New England to welcome the little *Bowdoin* back to her home port.



SUMACU RISES SHEER FROM THE PLAINS OF THE AMAZON

The way to this little-known extinct volcano led through dense jungle. This was the last of the Ecuador peaks scaled by the author.

Tungurahua could not rest; great masses of smoke continued to curl up from the crater, and it was not until twenty-four hours later that tranquillity was restored. Even then it was only for a brief period, as the very day we were packing up our kit the camp quivered and a heavy rumbling noise proclaimed the fact that the great giant was once more about to clear his throat.

MYSTERIOUS SUMACU BECKONS FROM AMAZONIA

Few people have ever reached the summit of Tungurahua, and even those who have ascended during periods of inactivity have not accomplished as much as we were able to do. Two ascents on two consecutive days, with an eruption thrown in, is a record which will not be challenged for some time.

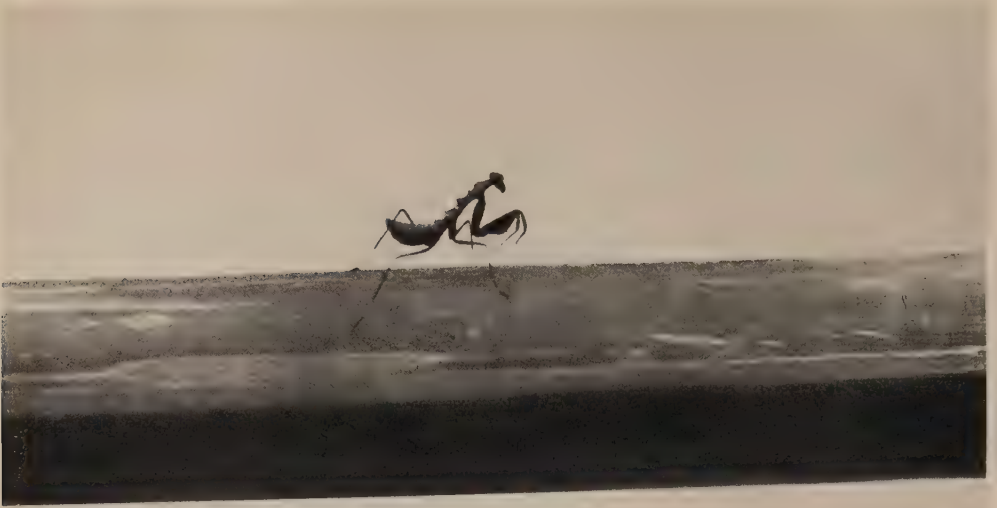
We now bade farewell to the ice and snow of the mountains and plunged into the great equatorial forests of Amazonia in search of Sumacu, an isolated peak which lies out on the Amazon plains, completely detached from the main cordillera of the Andes. It is one of the most re-

markable physiographic features in this part of South America and rightly deserves the name by which it is known to those brown shadows of the forest who live in jungle solitude around its base.

Sumacu Urcu means in English Beautiful Mountain. For centuries this great cone, rising steeply out of the plains, has been admired by every traveler descending the River Napo, and I have frequently wondered why no man has ever been tempted to solve its secrets. Its exact geographical position was determined by Sinclair and Wasson in 1921, but prior to our visit we knew of no written record that any human had ascended it or even explored around its base.

As a spectacular feat, the climbing of Sumacu cannot rank high, but the approach through dense virgin forests and the scaling of its thickly wooded sides represent a series of difficulties more real than apparent.

After leaving Baños, Johnston and I traveled over devious trails. We visited the Jivaro Indians, those warlike fellows, who have the habit of removing the head of an enemy and shrinking it down to the



HER ATTITUDE OF PRAYER CONCEALS A SAVAGE NATURE

The praying mantis, a lone meat-eater in a large family of vegetarian insects, assumes an attitude which suggests to human eyes a devout nature, and lies in wait for her victims. So savage is this insect Amazon that after the mating season she calmly devours her husband.



THE JUNGLE TURKEY PROVED A WELCOME ADDITION TO THE EXPEDITION'S LARDER

The feathers of this magnificent bird are bluish black and white and the beak is a dark orange color. A pronounced crest can be raised on the head at will. The meat is white and tender and highly esteemed by the Indians.



"GRANDPAPA" DISAPPROVES

The hairy saki, small and ferocious-looking denizen of the Amazon jungle, became known to the author's party as "Grandpapa" because of his serious expression and his long gray-tipped hair. He was encountered en route to Mount Sumacu.

size of an orange, as a souvenir of the chase. But others have described this tribe.* Suffice it to say that after many trials we arrived in the village of Napo, which lies crammed up against the great rock wall of the Andes, on the banks of the Napo River.

We descended this river in a large dug-out chartered from a trader in the locality, and after five days of easy going we turned into a northern tributary, the Payamino, up which we proceeded at the average rate of nine miles a day, until on

the fourth day we reached a collection of Indian huts. At this remote spot we started our long trek through dense forests which spread around the base of Sumacu.

MIGRATORY INDIANS MAKE TRAVEL
DIFFICULT

While in Napo making arrangements for transportation downriver we heard that José Schweitzer, a trader, accompanied by two padres from the mission at Tena, had just ascended Sumacu. This news came as a keen disappointment to me, for I had hoped that my small party would be the first climbers. Instead, I had

* See "Over Trail and Through Jungle in Ecuador," by H. E. Anthony, in the NATIONAL GEOGRAPHIC MAGAZINE for October, 1921.



INDIANS HUNT THE AGOUTI FOR HIS PALATABLE FLESH

This rodent is about the size of a rabbit and lives for the most part in the jungle. It can run very fast, and the Indians think that by eating the meat they will acquire some of its speed. These animals make destructive raids on the yucca plantations, which provide the staple food for the natives.

to take off my hat to Schweitzer and his enterprising band, relegating my companions and myself to second place. It was our good fortune to fall in with Schweitzer later on, and he joined our party in the capacity of guide, philosopher, and friend.

The one great difficulty we experienced in traversing this area was the scarcity of Indian inhabitants. In spite of the extraordinarily healthful nature of the region, there were few families occupying it, and those that did were as difficult to lay hold of as eels. They were here to-day and gone to-morrow, apparently dividing their time among numerous habitations hidden away in the deep recesses of the jungle. Out of possibly 28 Indian houses which we encountered, not more than six were occupied.

On early maps of South America names like Loreto, Avila, and San José are prominently marked; and, although they persist on the more up-to-date renderings of this particular area, they stand for nothing except a few dilapidated huts occupied at odd

intervals by the denizens of the jungle. No white man or even a half-caste lives nearer than the banks of the River Napo.

From the start we were handicapped by lack of porters. We employed men, women, and children. After one group of carriers had left us we might well have remained in the forest indefinitely had we not accidentally stumbled across a Huaynaro, or head Indian. He exercised some sort of control over all the forest dwellers, who seemed to appear and disappear among the trees like so many phantoms. Owing to his efforts, we eventually started.

An Indian track ran westward from San José toward the Andes. It passed fairly close to Sumacu, and along it our party traveled in company with eight cargo-bearers, three of them women. Constant downpours made the rivers well-nigh impassable and provided some thrilling experiences for Johnston, Schweitzer, and me.

The route we followed was a long series of switchbacks, with a final terrific slant up to the crest of Sumacu itself. We



GRASSHOPPERS SOMETIMES FLAVORED THE AUTHOR'S SOUP

Hordes of these insects made themselves objectionable to the members of the expedition by continually jumping into the food. They attain a length of four and one-half inches.



HALF-AND-HALF

The cow would not allow herself to be milked unless her calf were brought alongside simultaneously. Then the Indian woman and the calf took turns at milking until everybody was satisfied, with a minimum of trouble.



THE BABY OCELOT SPEAKS MUCH THE SAME LANGUAGE AS ANY OTHER KITTEN

A New World member of the cat family enjoys distinction both for its beauty and its amiability. This youngster, caught in the jungle near Sumacu, was taken to the London Zoo.



HE HAS TO BE EVER ON GUARD AGAINST THE TERRIBLE JAGUAR

Although no match for the jaguar as a fighter, the tapir sometimes escapes that animal's attacks by tearing madly into the dense jungle and sweeping his assailant from his back. The baby tapir will lose nearly all his white markings as he grows older.



THE CAPYBARA IS THE LARGEST OF ALL RODENTS

He has no tail and his feet are webbed. He is equally at home in water and on land. The young animal shown in this photograph will grow to be as large as a small pig.



AN INOFFENSIVE DENIZEN OF AMAZONIA'S FORESTS

Tapirs, like all the other game on the slopes of Sangay, seemed unafraid of man and could be approached as close as fifty feet without taking alarm. These strange animals live in the seclusion of dense woods, usually near the water, to which they retreat from their enemies.



AN INSECT MASTER OF THE ART OF CAMOUFLAGE

The phasmid, or stick insect, resembles a light green twig. So marked is this similarity of appearance that it is difficult to distinguish him from the tender shoots of the plants from which he dangles. He grows to a length of three and a half inches.

spent many nights in the jungle, camping under palm-leaf shelters, and we made our last camp at an elevation of 7,000 feet.

At 10 o'clock one morning we started the real ascent, a steady climb through a great variety of vegetation, in places so dense that we regretted we were not blessed with the prehensile tails of the monkeys about us.

The worst stage of the ascent was a tangled mass of shrubs so thickly matted that it was impossible to thrust a foot through the springy surface or to obtain a secure foothold on top of it. We were therefore obliged to depend on the gripping power of our hands to hoist and haul ourselves up.

Within 500 feet of the top this particularly aggravating growth thinned out and was replaced by coarse grass, over which it was comparatively easy to proceed. Schweitzer, Johnston, and I were well in the lead and by 5:30 in the afternoon had reached a bare shoulder 200 feet from the crest.

The boys, who had been struggling with cameras, had lagged so far behind we could not even see them. Accordingly we called a halt and, as it was exceptionally cold,

gathered a few dry twigs from some dead dwarf shrubs to make a fire.

The sun sank below the horizon and the temperature went with it. Johnston said he heard the thermometer hit zero; incidentally, he looked as if he had. Our miserable fire had no more heat in it than a firecracker. We shouted in chorus to our Indians, somewhere down the mountain side. There was no response, and we shouted again.

Meanwhile I took compass bearings on points of interest, including Antisana. We seemed to be due east of it. This, however, did not allow for magnetic variation, which Sinclair and Wasson determined to be $5^{\circ} 43' E.$ at the village of Napo. As darkness settled, and none of us relished the idea of being frozen to death at 12,700 feet, there was nothing to do but descend to a slightly warmer elevation for the night. Eventually we heard our men and within a short time we were all united.

WE BURROW INTO THE MOUNTAIN TO SLEEP

Have you ever watched a dog burrow in the ground, throwing the dirt back with his feet? That is just what we did on the

side of Sumacu. The ground was so steep that it was barely possible to sit down without rolling over; so we had to scoop out a niche in the side of the mountain.

We worked like madmen, tearing up the shrubs with our fists, slashing the surface soil with knives and scratching it away with our hands or anything that was convenient. Eventually, with our staffs stuck in a row at a good slant and our waterproof sheet hanging over them, we crawled underneath — Indians, white men, and baggage all jumbled together.

That was a pretty bad night and none of us complained when morning broke, even though it broke wet. Our few possessions were bundled up and at 5:30 the porters headed for camp, while Johnston and I, with the rain in our faces, began again to clamber upward and eventually reached Sumacu's summit. Mist and rain prevented our making many observations of importance, but we studied the peculiar contour of the peak and collected specimens of the outcroppings at our feet.

Sumacu is an extinct volcano. The crater is perfectly formed and shows little sign of erosion or weathering. The rim is highest on its northwest corner, and, like Sangay, gives evidence of a much larger crater having occupied the entire mountain top in years past. The present bowl is formed some 200 feet above the old crater and is about 1,200 feet across and 300 feet deep.



"MR. RACE HORSE BROWN" POSES FOR THE CAMERA

The pet of the party, a Humboldt's woolly monkey, deserved his name. "Race Horse" was applied because he moved so slowly, "Brown" because of his color, and "Mister" because it seemed more respectful than calling him plain Brown. He dined on fruit, with an occasional grasshopper or spider as an extra relish when he was fortunate enough to catch one.

Heavy rain and mist prevented our taking a single photograph. Both our still and motion-picture cameras had been lugged up all the way from the plains, and yet not a foot of film was exposed; so, in this respect, our raid on Sumacu proved a complete failure. It was just noon when we again set foot in camp, and in the luxury of food we tried to forget that for a day and night our only nourishment had consisted of a handful of beans.

By forced marches over hills and through rivers, we reached the banks of the stream



A VENICE OF AMAZONIA DURING HIGH WATER

When the River Javary is at the flood stage, the only means of getting about the villages on its banks is by canoe. In the dry season the edge of the stream is 60 feet distant.



THE RIVER WENT AWAY AND LEFT THEM

One of the vicissitudes which beset a traveler by dugout in Amazonia is the uncertainty of the rivers. He may tie up at night alongside a bank, pitch camp, and when he wakes next morning the level of the river may have fallen and he will find himself 100 yards or more from the main channel. If he cannot obtain native help in moving his crude, heavy canoes, he sometimes remains stranded for months before the river rises and sets him free.

WHALES, GIANTS OF THE SEA

Wonder Mammals, Biggest Creatures of All Time, Show Tender Affection for Young, But Can Maim or Swallow Human Hunters

BY REMINGTON KELLOGG

United States National Museum

THE mightiest mammal that ever lived on our planet is a whale. Some of the great Blue Whales, which may weigh 115 tons or more, would equal in length and far surpass in weight even the gigantic extinct dinosaurs, which were not mammals but reptiles (pages 57 and 68).

Other facts about the whale are as amazing as its size. The largest type of whale in existence, sometimes 100 feet long, can swallow nothing larger than a herring, and lives mostly on shrimplike creatures no bigger than grasshoppers.

Though it looks like a fish and can live only in water, the whale would drown like any land animal if it could not come up frequently to breathe, and it suckles its young on milk which is not essentially different from cow's milk.

Wounded whales sometimes are so ferocious that they have stove in and sunk small ships in their charges; yet many female whales seem almost human in their affection for, and defense of, their calves.

Dolphins, or porpoises, though smaller, belong to the same class of animals as whales, for they, too, breathe air and suckle their young. The two types are known collectively as cetaceans, and will be described together in this article.

There are two main kinds of whales, distinguished chiefly by their equipment for eating—the toothed whales and the “whalebone” or baleen whales. Toothed whales have teeth in the lower jaws or in both.

WHALE COULD HAVE SWALLOWED JONAH

Larger toothed whales, such as the Sperm and Killer, have throats big enough to swallow almost anything that lives in the sea, including giant squids,* seals, and sharks.

These whales could swallow a man, but even if he were not bitten in half he could not long survive the action of the powerful gastric juices. All dolphins and porpoises

have at least a few teeth in their jaws and capture living prey such as fish and squids.

The baleen whales, on the other hand, have no teeth, and their throats are only a few inches in diameter. Instead of teeth, they are equipped with whalebone, or baleen, which hangs down from either side of the upper jaws in long strips, with hairlike bristles on the inner edges.

The whale swims with open mouth through thick masses of small shrimplike crustaceans that live near the surface. When its mouth is full the whale closes it. Then, with its huge tongue, it forces the water out at the sides through the strips of baleen (page 37). This acts like a sieve, retaining the food, which is thereupon swallowed. A large baleen whale may eat several barrels of such food in a day. Toothed whales have only one blowhole, or nostril; baleen whales have two.

MACHINE AGE IMPERILS SUPPLY

Whales once roamed by the millions in the oceans of the world, but today they may be heading toward the same fate that pursued the once-vast herds of American buffalo. Three-quarters of a million whales have been killed since 1900.

Today whales are hunted with harpoons shot from cannon, and the carcasses are processed at sea on huge “factory ships” equipped to reduce them quickly to oil and other products (pages 66, 67, 70). As a result of these improved methods of pursuit and handling, as well as the discovery of new uses for whale oil in such things as margarine and soap, the search for whales is now more active than ever before.

It was only about 300 years ago that naturalists discovered that whales and other cetaceans are not fishes, but are related to

* See “Marauders of the Sea,” by Roy Waldo Miner, with 8 paintings of squids and octopuses, NATIONAL GEOGRAPHIC MAGAZINE, August, 1935.

The remarkable series of 31 paintings by Else Bostelmann accompanying this article is the first complete set of full-color pictures of the better-known whales, dolphins, and porpoises to be printed.—Editor.



Photographs © N. Y. T. and St. L. P.-D.

THREE STAGES IN A WHALE'S BREATHING

Little Piked Whales (Plate II), photographed on the Byrd Antarctic Expedition I, are shown in all three pictures. Bottom: Blowholes start to open as head rises above water. Middle: Blowholes open, just after discharge of breath. Top: Blowholes (left) distended as whale inhales air. Other whale is diving. All appear in open leads in the ice.

mammals that live on dry land. All cetaceans have smooth skins, devoid of hair or scales. All have a streamlined form superficially similar to that of fish, though their lengths vary from 100 to 5 feet.

Flippers of cetaceans bear little resemblance to the fore limbs of land mammals, for they are fashioned like paddles and are employed mainly for steering and balancing. No external trace of hind limbs persists in any of the living cetaceans. We are fairly certain that these limbs were present in their immediate ancestors, since living cetaceans have one or two vestigial hind limb bones buried deep in the flesh.

Hind limbs apparently served no useful purpose and the propelling function was taken over by the powerful flukes at the end of the tail. Unlike the tail of a fish, these flukes are horizontal. The greatest velocity is obtained by alternate upward and downward strokes of these flukes.

Since the external nostrils, or blowholes, of cetaceans are located on the top of the head, they can breathe without exposing much of the body above the surface. Water does not enter the lungs when the animal rushes with open mouth in pur-



© Morris D. Miller

WHALEBONE HANGS LIKE HEAVY FRINGE IN A HUMPBACK'S YAWNING MOUTH

The bushy material, also called baleen, is attached to either side of the upper jaws of the Humpback Whale (Plate VI). It serves to strain the whale's food of small shrimplike creatures from sea water (pages 35 and 38). The gigantic tongue lies in the lower jaws, below. Note barnacles on the chin and throat. This whale carcass is on the deck of the American "factory ship" *Frango* off the west coast of Australia. Lieutenant T. R. Midtlyng, U. S. Coast Guard, whaling inspector on the ship, is pointing to a peculiar growth on the bony ridge of the upper jaws.

suit of food because the nasal passages, instead of opening into the throat as in land mammals, are connected directly with the windpipe.

THE TECHNIQUE OF "SPOUTING"

The popular belief that water enters the mouth when the whale is feeding and is spouted out of the blowholes on top of the head is wholly erroneous. Actually, the "spouting" is produced by air forcibly discharged from the lungs. When the atmosphere is cold enough to condense the warm, moisture-laden breath, the "spout" can be seen rising high, geyserlike.

How deep a whale can dive safely is uncertain. When feeding, the whale makes periodic submergences, since the food sought

is found at varying levels. A harpooned whale may dive to greater depths.

In April, 1932, the cable repair ship *All America*, while investigating the cause of an interruption in the service of the submarine cable between Balboa, Canal Zone, and Esmeraldas, Ecuador, hoisted to the surface a dead 45-foot Sperm Whale from a depth of 3,240 feet off the coast of Colombia.

The cable was twisted around the lower jaw of the animal and an additional 180 feet was wrapped around one flipper, the body, and the caudal flukes.

WHALES WEEP GREASY TEARS

At such a depth the body of the whale must have been subjected to a pressure of approximately 1,400 pounds per square

inch. It is not likely that the other cetaceans, with the possible exception of the Bottlenose Beaked Whale, ever dive to such depths.

Since cetaceans spend their entire lives in the water, their bodies are blanketed with a layer of blubber to prevent rapid loss of body heat. Tear glands of whales secrete a greasy substance that guards the eyes against the irritation of sea water. Whales possess no external ears, but they can detect water-borne sounds.

A WHALE'S "COLD TABLE"

Baleen whales depend for their livelihood on "food banks," vast masses of small crustaceans, resembling shrimp, that come to the surface to feed on diatoms and plankton, which are tiny plants and minute forms of animal life that live in the sea.

Nature's plan for producing the food banks is fascinating. They are found in high latitudes in spring and summer in regions where cold polar currents mix with warmer ocean waters. This mixing produces just the right temperature, which, combined with action of the radiant energy of sunlight and nourishing salts in the water, provides a favorable environment for vast quantities of microscopic plants and animals to come into existence. They multiply in such numbers that large areas of surface waters are colored brownish or greenish.

Then immense swarms of small shrimp-like creatures come to the surface to spawn and feed upon this accumulation of provender. Next come the whales, eating in their turn the crustaceans which have eaten the smaller organisms.

Migration routes of the baleen whales depend largely on the seasonal locations of these floating food supplies. The whales go north or south to cooler waters to find the food banks in summer. As the surface water grows colder, however, the food sinks to greater depths, and the whales turn back to the Tropics, where they bring forth their young during the winter months.

Most of the larger baleen whales commonly display such strong affection for their calves that whalers for centuries made a practice of harpooning the young first. The cow then became an easy prey, since she refused to leave her dead offspring.

Dolphins and porpoises are not noted for the defense of their young. Nevertheless, the females keep their calves close beside them and no doubt endeavor to protect

them from the attacks of their natural predatory enemies. The young dolphin is able to keep up with the pace set by the school as soon as it is born (p. 88). Normally, female cetaceans give birth to single young.

Whales have been hunted for more than a thousand years. When they were pursued in small ships, and the killing was done with hand harpoons by a few men in a small boat propelled by oars, whaling was necessarily limited to animals that floated when dead, such as the Right Whale, Bowhead, and later the Sperm Whale.

The larger "finner" whales, including the Finback, Blue Whale, and Sei Whale, and also the Humpback, sink when killed. Moreover, these animals were too speedy and dangerous to be hunted successfully until the perfection of the harpoon gun about the middle of the 19th century. This also permitted use of a heavier harpoon line, by which the whales could be hauled to the surface to be pumped full of air so that they would float.

The ever-increasing demand for whalebone, or baleen, led to an amazing expansion of the whale fishery. Men endured constant hardships in the pursuit of whales for whalebone, but is doubtful that they were at any time much more uncomfortable than the ultimate consumer, the fashionable woman of that day, who willingly subjected herself to the discomforts of garments braced with whalebone.*

WHALEBONE AIDS TO BEAUTY

Bustles, basques, and bodices were stiffened with thin strips of whalebone; high collars and ruffs were braced with this material, and the billowy hoop skirt would have been literally a "flop" without its presence.

In the years between 1890 and 1902, whalebone sold for a top price of \$5 to \$7 a pound and a single Bowhead Whale would yield from 1,500 to 3,300 pounds. But when steel corset stays came to be substituted for whalebone, many holding large stores of this material went bankrupt.

Whale oil was suitable for nearly all the diversified uses for which oil was required. Soaps to preserve complexions and to wash clothes were made of it. Homes were lighted with lamps filled with whale oil or with candles made of spermaceti. In 1819

* "Whalebone" refers only to the horny material taken from the mouth of the baleen whale. The huge bones of the whale's skeleton are ground up for use as fertilizer.



Photograph by Frank Salisbury

LEAPING HIGH OUT OF WATER, DOLPHINS ESCORT AN AUSTRALIAN VESSEL

In similar fashion, a dolphin known as "Pelorus Jack" swam ahead of ships entering and leaving Pelorus Sound, New Zealand, for about 32 years (page 85). These animals are Dusky Dolphins (*Lagenorhynchus obscurus*) and were photographed from a ship between Sydney and Brisbane. They frequently are seen along the coasts of Australia and New Zealand. Among the smaller cetaceans, those with beaks are called dolphins, and those without are porpoises.

the streets in several English towns were lighted by a gas made from whale oil.

Manufacturers used the oil in making varnishes and paints, in finishing leather and coarse woolen cloths, in cordage manufacture, screw cutting, and steel tempering.

The perfection of the kerosene lamp, the gas mantle, the electric light, and the change in women's fashions allowed the whale a respite for some years. But with the World War came an enormous demand for glycerine, obtainable from whale oil, to be used in manufacture of munitions. Whaling operations were suspended in the North Atlantic because of the war and large-scale hunting of Antarctic herds followed.

Since then, the Antarctic production of whale oil has increased year by year, with 3,340,330 barrels reported in 1937-38. The war in Europe again has increased the demand for whale oil, for making glycerine and edible fats such as margarine. It is used to a less extent for currying leather, fiber dressing, face creams, and ointments. A whale of average size also yields about four tons of meat and fertilizer.

PERFUMES FROM SICK MAMMALS

The most valuable of all whale products, however, is ambergris, a grayish, spongy substance which is found only in the intestines of sick whales. It commands high prices in making quality perfumes.

Year after year, whaling has taken a toll in excess of the natural rate of reproduction, and one region after another has been depleted. Operations are shifted from exhausted grounds to promising new fields, and here the process is repeated. Overfishing probably will bring to an end the present operations in the Antarctic areas before many years pass.

The present-day harpoon, which is fired from a maneuverable cannon at the bow of a small "catcher" boat, has strong barbs on its sides that open after it has entered the whale's flesh, and contains a bomb that either kills or fatally wounds the victim. The *Terje Viken*, largest whaling factory ship now in use, is 633 feet long and is rated at 30,000 dead-weight tons. Ten whale-catcher boats are needed to kill sufficient whales to keep this factory ship operating 24 hours a day.

The rapidity with which whales have been killed since 1900 is appalling. More than 46,000 whales, including 14,923 Blue, 28,009 Finbacks, 2,079 Humpbacks, 161

Sei, and 867 Sperm Whales were killed in 1937-38 in the Antarctic alone. During the season 1938-39 no fewer than 2 shore stations, 34 floating factories, 281 whale-catcher boats, and at least 12,705 men were engaged in whaling in the Antarctic.

Warnings have been repeatedly given that the scale of operations and the methods employed in the modern whaling industry constitute a menace to the maintenance of the stocks of whales. By an international agreement that came into force in 1935, full protection was given to all kinds of Right Whales; the killing of calves, immature whales, and females accompanied by calves was prohibited, and fullest possible use of all whale carcasses was required.

Later agreements bar factory ships from tropical calving grounds of whales; increase the minimum length of whales that can be legally killed; prohibit killing Humpback Whales in the Antarctic, Gray Whales in the North Pacific, and establish an Antarctic whale sanctuary between the Ross Sea and Cape Horn.

In spite of these agreements there has been no marked reduction in the total number killed. If the exploitation of the whale stock continues on the present scale, the time will come in the very near future when whales will become much less numerous on the "grounds," the price of whale oil will rise, and consequently whaling operations will be intensified. Overfishing and the resultant scarcity of whales will automatically make it economically impossible to operate floating factories.

Sperm Whale

(*Physeter catodon*)

Of all the living toothed whales, the Sperm Whale, or Cachalot, is the largest and probably most widely distributed (Plate I). Females and calves are found the year round in tropical waters, but old males in summer travel to or beyond the latitude of the South Shetland Islands of Antarctica on the south and Iceland and the Bering Sea on the north.

Before 1800, American whalers were going to the Pacific Ocean on sperm whaling voyages lasting two to three years. Spermaceti, a whitish, oily substance found in an enormous reservoir in the Sperm Whale's head, was valued for making clear-burning candles.

Male Sperm Whales grow considerably larger than females, the greatest known length being 65 feet. They are a uniform gray or dark bluish gray, with several shallow ridges on back and flanks. The relatively narrow, slender

WHALES, PORPOISES, AND DOLPHINS



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Painting by Else Bostelmann

MADDENED BY THE HARPOON, SPERM WHALES OFTEN SMASHED PURSUING BOATS

It is appropriate that the most colorful and pugnacious of all whales should head this series of paintings, which represents the first attempt to gather pictures of all the better-known whales, dolphins, and porpoises in a single group. "Moby Dick," made famous in Herman Melville's book, was a **Sperm Whale**, and could easily have bitten off a man's leg as the story relates. The sperm was widely hunted by the old New England whaling fleets. Once common in the Atlantic and Pacific, it now is found chiefly off Japan, Chile, and Natal.



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LARGEST MAMMAL THAT EVER LIVED ON LAND OR SEA IS THE BLUE WHALE, SOMETIMES 100 FEET LONG
Painting by Else Bostelmann



Painting by Else Bostelmann

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A RIGHT WHALE CALF SNUGGLES CLOSE TO ITS MOTHER'S SIDE AS THE TWO COME UP FOR AIR

In the mother's mouth are seen the strips of baleen, or whalebone, which strain bushels of tiny creatures like shrimp from the water as the animal swims. **Right Whales**, natives of the North Atlantic, have small throats and no teeth, so cannot eat large fish. A rare **Pygmy Right Whale** rises below.



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ITS NEVER-ENDING SEARCH FOR FOOD CARRIES THE SEI WHALE ALMOST FROM POLE TO POLE

Painting by Else Bostelmann



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Painting by Else Bostelmann
FASTEST SWIMMER AMONG WHALES, THE STREAMLINED FINBACK GULPS DOWN HERRING BY THE BARREL AND CODFISH BY THE HUNDRED
When feeding it turns on its side, and water spurts out between the strips of baleen as its jaws close on a mouthful of fish or shrimp. **Finbacks** are
found in all oceans, but this school is off South Georgia, British island in the South Atlantic.



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Painting by Else Bostelmann

TURNED ON HER SIDE, A MOTHER HUMPBACK WHALE NURSES HER CALF

This position brings the teats above the surface. Later the baby will be able to nurse under water. Whale milk is yellowish and oily. The **Humpback** in the foreground is seen from above, showing the two slitlike blowholes, or nostrils, and the fleshy knobs on the snout. In the background a Humpback leaps clear of the water, one of the most spectacular maneuvers performed by any whale. This animal is widely distributed in the oceans of the world.

WHALES, PORPOISES, AND DOLPHINS



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GRAY WHALES, ATTACKING HARPOONERS, EARNED THE NAME OF "DEVIL-FISH"

Their frenzied rushes after being wounded often upset or stove in the small boats of old-time whalers. Female **Gray Whales** battle fiercely to defend their calves. This animal lives only in the North Pacific Ocean, and seems to prefer to stay close to shore, as do these individuals off the coast of southern California. Often they swim into shoal water and apparently enjoy rolling ponderously in the surf, without fear of becoming stranded.



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Painting by Else Bostelmann

ALMOST ONE-THIRD MOUTH IS THE BULKY BOWHEAD WHALE OF THE ARCTIC

The gigantic lips enclose a boat-shaped space large enough to hold several men. Whalebone from its mouth brought four dollars a pound in the "gay nineties," when it was used in corsets, but the advent of steel stays as a substitute ruined the industry. These **Bowhead Whales**, swimming among Arctic icebergs, are being attacked with hand harpoons by men in small boats, a method now little used.



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Painting by Else Bostelmann

SUDDEN DIVES OF THE BOTTLENOSE HAVE DRAGGED MANY A WHALER TO DEATH

A denizen of North Atlantic waters, this whale still is hunted with hand harpoons. So fast is its dive that if a man is caught in a loop of the uncoiling harpoon line he will be yanked deep under water and drowned. This danger existed in hunting all whales in the days when they were pursued only in small boats, and thus Captain Ahab meets his end in the novel, *Moby Dick*. Old males of the **Bottle-nose Whale** family sometimes are almost pure white.



WITH ONLY TWO TEETH, TRUE'S BEAKED WHALE STILL EATS WELL
Only eight specimens have been seen by naturalists, all in the Atlantic. Apparently **True's Beaked Whale** lives far from the haunts of man. It eats squid and other fish.



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SCARS OF BATTLE DISFIGURE THE HIDE OF THIS CUVIER'S BEAKED WHALE

The pairs of scratches were made by the two teeth in the lower jaws of a pugnacious rival during the mating season. **Cuvier's Beaked Whale**, sometimes called "goose-beaked," is found the world over. Some females are brown beneath, with a central spotted area.

WHALES, PORPOISES, AND DOLPHINS



MYSTERY STILL PARTLY CLOAKS THE RARELY SEEN ROUGH-TOOTHED DOLPHIN
Few naturalists ever have observed one in the flesh. The crowns of its teeth are roughened by fine vertical ridges. The **Rough-toothed Dolphin** has been seen by sailors in most of the oceans.



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POCKET EDITION OF MOBY DICK IS THE PYGMY SPERM WHALE

Like its giant relative (Plate I), it has sharp, backward-curving teeth in the lower jaw only, a reservoir of spermaceti in its head, and lives largely on cuttlefish. The **Pygmy Sperm** is believed to inhabit both the Atlantic and Pacific Oceans.



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THEIR HABIT OF "FOLLOW THE LEADER" IS DISASTROUS WHEN A SCHOOL OF BLACKFISH, OR PILOT WHALES, OR FISHMEN take advantage of the animals' instinct to follow the largest member of the school and force them into shallow water where they are easy prey.



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SAVAGE KILLER WHALES, WHICH CAN SWALLOW A SEAL OR EVEN A MAN, ATTACK A HERD OF SMALLER WHITE WHALES

Armed with sharp teeth in both upper and lower jaws, the **Killer Whale** fears no living thing. Males reach a length of 30 feet. Killers capture seals or penguins on ice floes by smashing or upsetting the floes from beneath. The timid **White Whale** frequents waters of the Arctic coasts and rivers.



SCHOOLS OF DALL'S PORPOISE RACE BOATS IN ALASKA'S INSIDE PASSAGE

A group of two dozen regularly met and escorted a Government boat on its daily trip for two months near Wrangell, Alaska. **Dall's Porpoises**, about six feet long, are seen mostly in the waters of the Inside Passage and near Kodiak and the Aleutian Islands.



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THE HANDSOME RIGHT WHALE DOLPHIN SEEMS TO BE WEARING A TUXEDO
Like its larger namesake (Plate III), it has no dorsal fin. The **Right Whale Dolphin** lives far offshore in the North Pacific Ocean, and has relatives in waters off Japan and in the South Pacific.

WHALES, PORPOISES, AND DOLPHINS



LONG TEETH IN THE LA PLATA DOLPHIN'S BEAK ARE BAD NEWS FOR FISH

It inhabits river estuaries and parts of the coasts of Argentina and Brazil. A brown baby swims close to its mother. Curiosity, or carelessness, often brings the **La Plata Dolphin** alongside fishing boats, where it is easily captured.



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THROUGH FAR-FLUNG JUNGLE STREAMS SWIMS THE AMAZON RIVER DOLPHIN

Sometimes called the **Bouto**, it lives in the great system of waterways centering around the stream for which it is named. The **Amazon River Dolphin** is eight to nine feet long.



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Painting by Else Bostelmann

WHITE-BEAKED AND WHITE-SIDED DOLPHINS OFTEN LEAP HIGH OUT OF WATER

Frequently they are washed on shore. Despite its name, the male **White-sided Dolphin** is chiefly conspicuous because of the yellow stripes on its flanks. The **White-beaked Dolphin** (center and background) is similar in appearance except for its coloring. These animals live in the North Atlantic Ocean, from Norway to Cape Cod, Massachusetts. Both types sometimes travel in schools of 1,000 or more individuals. They grow to a length of nine or ten feet, with very short beaks.

lower jaws are furnished with 20 to 30 heavy teeth (page 63).

The Sperm Whale calf, which measures 13 to 14 feet at birth, is suckled by the mother at least 6 months and is weaned after attaining a length of 21 or 22 feet. The female, when suckling her calf, floats on her side, while the calf, which is thus enabled to breathe normally at the surface, takes the protruded nipple in the corner of its mouth.

Sperm Whales live 8 or 9 years. Requiring a ton of food a day, they feed principally on squids and octopuses, as indicated by circular scars on the head and jaws left by the suckers and claws of these cuttlefish.

In "sounding," or diving, the Sperm Whale lifts its caudal flukes high in the air and goes down almost vertically. On coming to the surface after a dive of from 20 to 30 minutes, the instant the end of the snout breaks the water the low, bushy spout bursts forth, directed diagonally forward. Following a prolonged submergence, the Sperm Whale makes about 40 shallow dives. It swims at about four knots, but when frightened can triple this speed.

Blue Whale

(*Sibbaldus musculus*)

The summer haunts of Blue Whales are near the polar pack ice of both hemispheres, and they seem to avoid the Tropics (Plate II). They depend on small crustaceans for food and their wanderings appear to be correlated with the periodic abundance of these organisms.

The Blue Whale is the largest mammal that has ever lived either on land or in the water (page 35). Three females 100 feet in length have been taken in the Antarctic in one season. A Blue Whale 89 feet long and 45 feet in maximum circumference weighed more than 119 tons; it yielded 166 barrels of oil.

Although this whale's body has a decidedly bluish cast, the shoulders, back, and sides generally have a diffused paler mottling of small grayish patches, and the belly, including the area of the throat folds, is unevenly mottled with scattered silver-gray and white spots of irregular shape. A yellowish or sulphur-colored film of diatoms may form on the animal's under surface, giving rise to the name "sulphur-bottom" used by American whalers. The blades of whalebone are black-blue or coal-black, and from 23 to 41 inches long.

A Blue Whale calf, 23 to 26 feet long at birth, is nursed by the mother for about seven months and is weaned when it has attained an average length of 52 feet. The life span apparently does not exceed 20 years. The Blue Whale feeds on small crustaceans called "krill." The mass of such shrimplike animals in the stomach of one large Blue Whale weighed more than a ton.

The Blue Whale generally makes a dozen or

more shallow dives of 12 to 15 seconds after coming up from a deep dive. The columnar vaporized spout, which may rise 20 feet, is delivered when the vertex of the head first appears at the surface. At the beginning of a deep dive that may last 10 to 20 minutes, the great caudal flukes rise clear of the water.

Pursuing whale-catcher boats have found that the normal speed of a Blue Whale when traveling is 10 or 12 knots, but a frightened animal may exceed 14 knots.

Little Piked Whale

(*Balaenoptera acutorostrata*)

The Little Piked Whale seems to be partial to inshore coastal waters (Plate II and page 36). Strictly speaking, the name *Balaenoptera acutorostrata* applies only to the North Atlantic Little Piked Whale, since the Antarctic form has been named *Balaenoptera huttoni*, and the one that occurs in the North Pacific has been called *Balaenoptera davidsoni*. Since their external features are much the same, all will be treated here as one species. On this basis, the Little Piked Whale has a world-wide distribution, ranging northward to Spitsbergen, Iceland, Baffin Bay, and Bering Sea, and on the south penetrating Ross, Weddell, and other Antarctic seas. Because of its small size, it has little commercial value.

Not only is the Little Piked Whale the smallest of all the furrow-throated whales, but it is readily recognized by the broad white band crossing the upper side of the fore flipper and by the entirely white or yellowish-white whalebone. Its length seldom exceeds 33 feet. Throat folds, from 50 to 70, extend from the chin backwards onto the chest.

The bluish-gray, brownish-gray, or grayish-black coloration of the head, lower jaws, and back becomes lighter on the flanks. Ordinarily the entire throat, chest, and remainder of underparts, with the exception of four or five outer folds, are ivory white. Scottish fishermen gave this whale the name "Little Piked" on account of its high and pointed dorsal fin.

Probably this whale feeds more on fish than do its larger relatives. It is seen in the colder waters of the Northern and Southern Hemispheres during the respective summer seasons, but rarely remains there during the winter.

Right Whale

(*Eubalaena glacialis*)

For at least 700 years (1100 to 1800) the Right Whale was successively hunted in the Bay of Biscay, along the northwestern coast of Norway, around Iceland, in the Gulf of St. Lawrence near Newfoundland, and along the coasts of New England (Plate III).

Its abundance, slow speed, buoyancy of its carcass, and great yield of oil and whalebone made it an attractive quarry. For these reasons it was called the "right" whale.



Photograph by Merl La Voy

A WHALE'S "OVERCOAT" OF BLUBBER MAY BE SIX OR MORE INCHES THICK

A blanketlike layer of fat is being peeled off the head of a Sperm Whale (Plate I) by a chain and donkey engine at a shore station in the Aleutian Islands. The blubber, which keeps the animal warm in cold seas, is melted down into oil. The carcass is lying on its side. The man's left foot is resting on the long, narrow lower jaw, which is small in proportion to the rest of the huge head. No other whale has a mouth and head like this.

Actually there are three recognizable kinds of Right Whales, of which one (*Eubalaena glacialis*) inhabits the North Atlantic Ocean, another (*E. australis*) the oceans in southern latitudes, and a third (*E. sieboldii*) the North Pacific Ocean.

The Right Whale is related to the Bowhead, or Greenland Whale (Plate VIII), and like the latter is characterized by the absence of external throat furrows, lack of a dorsal fin, presence of long, narrow blades of black whalebone, and enormous fleshy lower lips on the outward-bowed lower jaws.

Adult Right Whales generally average from 45 to 50 feet long. The short and chunky body is often entirely black, although about one out of five individuals is white-bellied. Near the end of the muzzle of adults and young is a horny excrescence of irregular shape known as the "bonnet," commonly infested with parasitic worms, whale lice, and barnacles. The row of black whalebone suspended from each upper jaw consists of at least 250 flexible blades, of which the central ones are the longest, averaging from six to seven feet. The female has a single young which she suckles and keeps with her for at least a year.

Right Whales are fond of floating on the sur-

face, and at times are playful, springing nearly clear of the water. Usually a series of five or six shallow submergences is succeeded by a deep dive of 15 to 20 minutes' duration. The V-shaped spout is double, the forcibly ejected breath from each blowhole being directed forward and upward some 15 feet.

Pygmy Right Whale

(*Neobalaena marginata*)

Pygmy Right Whales are either few in number or their habits are such that they are rarely seen by whalers (Plate III). Stranded specimens have been found on the eastern coasts of the Great Australian Bight, most frequently in the spring at the time of heavy gales, and in various New Zealand waters.

Probably less is known about their habits than of any other cetacean. Measurements of skeletons indicate that they attain a length of 20 feet. The throat is smooth. The blades of whalebone are ivory white or yellowish white, with a blackish outer margin.

One of the most remarkable features of the Pygmy Right Whale's body is the presence of 17 pairs of peculiarly widened ribs, a greater number than is found in any other cetacean. Some zoologists believe that these ribs provide



Photograph by Merl La Voy

GIANT WHALE JAWBONES SERVE AS AN ALASKAN CEMETERY FENCE

In a land where wood is scarce, this burying ground at Point Hope, Alaska, is surrounded instead with the lower jawbones of Right and Bowhead Whales, which formerly were plentiful in Arctic waters. Some of these bones reach a length of 21 feet. In prehistoric times such bones were used by the Alaskan Eskimos as roof beams for their semisubterranean houses.

additional protection to the internal organs and may be related to deep diving habits.

Sei Whale

(*Balaenoptera borealis*)

Sei Whales migrate in search of food during the warmer season to the colder waters some distance from the pack ice and when winter sets in they return to tropical or subtropical waters for breeding and calving (Plate IV). They range northward to Spitsbergen, Iceland, and the Bering Sea, and southward to the northern limit of drift ice in the Antarctic seas. Except near Japan, Korea (Chosen), and the west coast of Norway, they are of no great importance on any of the whaling grounds, for their oil yield is low.

This whale rarely exceeds 56 feet in length. The upper parts are nearly always gray, often dark steel gray or a gray with a bluish cast. On the flanks and sides of the tail the color is generally light bluish gray, but occasionally with small irregular spots of the color of galvanized iron. Oblong white scars left by parasitic copepods are usually scattered over the body. The mid-portion of the underparts from the chin backwards is white, the remainder, including the lower jaws, being the same color as the upper parts.

Sei Whale calves at birth are from 15 to 16 feet in length, are suckled for at least five months, and are weaned when they have attained a length of 26 to 30 feet. Old age is reached at 15 years. They are plankton feeders.

Norwegian fishermen call this animal the Sei Whale (*Seiehval*), since it arrives on their coasts simultaneously with the *sei*, or coalfish. The English equivalent is "pollack whale."

This whale generally comes to the surface obliquely, so that the observer sees in succession the snout, the top of the head, and then the delivery of the spout, which is accompanied by a metallic whistling sound. The moisture-charged breath forms a cone-shaped column that rises from 10 to 14 feet.

Bryde's Whale, which somewhat resembles the Sei Whale in outward appearance, is common on the coast of Cape Colony.

Finback Whale

(*Balaenoptera physalus*)

Finback Whales are found in all large oceans, assembling in schools of a few to two or three hundred in areas where food is plentiful (Plate V). About 250,000 Finbacks have been killed since 1900.

Few whales can compete with the Finback in speed. A long tapering body, elongate wedge-



Photograph from Captain George T. Plummer

WHALE SHIPS AND CASKS OF WHALE OIL CONGESTED THE WHARVES AT NEW BEDFORD, MASSACHUSETTS, 80 YEARS AGO

This was a typical scene along the water front when the city was the world center of the whaling industry. American vessels engaged in the "fishery" far outnumbered all others. Ships like these sometimes went on voyages lasting two or three years and added greatly to geographic knowledge of remote parts of the world.



Photograph from Captain George T. Plummer

WHAT THE GOLD RUSH OF 1849 DID TO THE AMERICAN WHALING FLEET! DOZENS OF DESERTED SHIPS WERE TIED UP AT SAN FRANCISCO Verba Buena Island, background, is now a stepping stone for the $8\frac{1}{4}$ -mile Bay Bridge connecting San Francisco with Oakland, California.



© Morris D. Miller

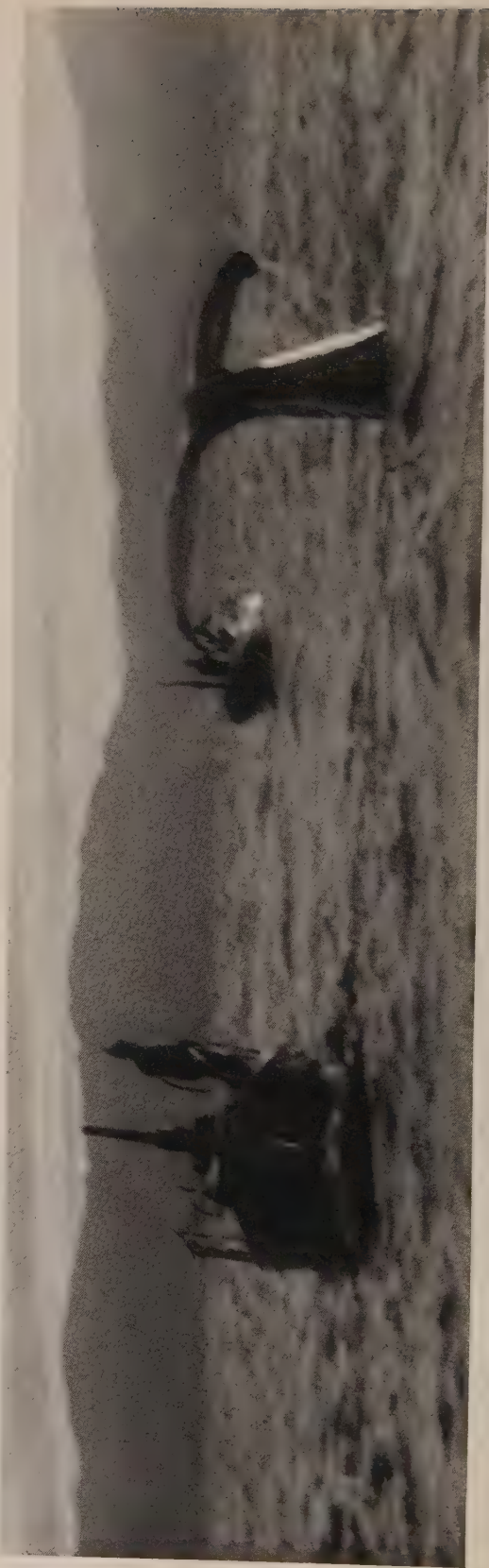
FEW WHALES CAN ESCAPE MODERN FAST "KILLER BOATS" WHICH SUPPLY THE "FLOATING FACTORIES"

This fleet killed more than 900 whales in three months for processing on the American whaling ship *Frango* off western Australia in 1938 (page 37).



HARPOONED BY A GUN FROM THE BOAT, A HUMPBACK WHALE BREACHES AFTER A DIVE

Knobs on the snout are characteristic of the Humpback (Plate VI and page 65). The New Zealander in the bow of the boat is hauling in the slack line.



FLUKES LASHING THE AIR, A WOUNDED HUMPBACK DIVES IN ITS DEATH THROES

A grenade on the harpoon first stuns the whale, and then it is killed by explosion of a bomb attached to a line. For a full description of the process, see page 65.

Photographs courtesy The Auckland Weekly News



Photograph from International Press Photo Service

TWO HUGE SPERM WHALES, RELATIVES OF THE FICTIONAL "MOBY DICK," PROVIDE A SPECTACLE FOR ROTTERDAM CROWDS

These adult males were cast ashore February 24, 1937, in the southern part of the Netherlands. The animals measured 59 and 52½ feet, and weighed 52 and 39 tons, respectively. The whale in the foreground is on its side, showing clearly the shape of the long, narrow lower jaw, small by comparison with the rest of the head (Plate 1).



Photograph by B. Anthony Stewart

THE WHALER "LAGODA" ONCE WAS GONE FROM NEW BEDFORD ALMOST FOUR YEARS

During the voyage, she captured whales valued at more than \$200,000. This model is 59 feet long. It is housed in the Bourne Whaling Museum, connected with the Museum of the Old Dartmouth Historical Society, at New Bedford, Massachusetts. This town and Nantucket Island, near by, were the two leading American whaling ports of the 19th century. At the cry of "Thar she blows!" from the masthead, the boats (right) would be lowered from the davits and rowed or sailed in pursuit of the whale (page 82).

shaped head, high curved dorsal fin, and tapering fore flippers all contribute to its graceful lines. Old adults reach a length of approximately 82 feet. The back is sharply ridged toward the tail, and the throat furrowed.

Finbacks are normally dark gray above and snow white beneath. Curiously, the right side of the head is more whitish than the left. The longest blades of whalebone measure 20 to 36 inches. The long bristles hanging from the inner edge of each blade are whitish or yellowish.

Calves measure 21 or 22 feet at birth and are nursed for at least six months. Finbacks may reach the ripe old age of 20 years.

The animal expels its vaporous breath to a height of 15 or 20 feet at the instant the blowholes on the vertex of the head break the surface of the water. The spout rises vertically as a narrow column at first and then expands into an elongated ellipse before it is dissolved.

Humpback Whale

(*Megaptera novaeangliae*)

Humpbacks are generally distributed in the oceans of the world according to season and feeding conditions (Plate VI). These whales migrate along well-defined courses at definite seasons, pass the winter in tropical or subtropical waters, and return to the polar seas in the spring (pages 37 and 62).

A thickset body and long fore flippers give the Humpback an ungraceful appearance. The obtusely rounded snout of the flattened head and the rows of rounded knobs on the snout and lower jaws have convinced more than one inexperienced ocean traveler that he has seen some strange sea serpent. Humpbacks are normally black except for the white throat and breast. The whalebone blades are grayish black, with bristles four to six inches long.

At nursing time the calf demonstrates its playful affection by leaping and splashing around its mother until sharply called to the business at hand by several slaps from her long flippers.

The calves, which measure 15 to 16 feet and weigh more than 3,000 pounds at birth, are nursed for about a year. The average length of old adults is around 48 feet.

Favorite food of the Humpback seems to be small shrimplike crustaceans. Along the coasts of Norway and Labrador, Humpbacks follow large schools of capelin, a small smeltlike fish.

Humpbacks are noted for their playful antics, such as "lob-tailing," when the partially submerged whale is seemingly standing on its head, thrashing the surface water into foam by powerful strokes of its flukes. More remarkable is its habit of "breaching," or jumping clear of the water in a vertical direction and then falling on its side with a great splash.

Gray Whale

(*Rhachianectes glaucus*)

The shore-loving Gray Whale is found only in the North Pacific Ocean (Plate VII). Along the western coast of North America it migrates in winter as far south as the latitude of the State of Jalisco, Mexico, returning to the Arctic Ocean in the spring. Other herds of Gray Whales that pass the summer in Okhotsk Sea, along the Kamchatka coast and the Arctic Ocean, appear off southeastern Korea (Chosen) toward the end of November on their southward migration.

The Gray Whale has only two to four short throat furrows, a slight hump but no distinct dorsal fin. It attains a maximum length of about 50 feet and, like other baleen whales, the females average larger than the males. Although the general coloration is black or very dark slate, the whole body from head to caudal flukes is usually marred by many white or light-gray circular scars, presumably left by parasitic cirripeds such as barnacles. The largest blades of whalebone in its mouth are from 14 to 18 inches long. These blades are thick and heavy, yellowish white or light yellow.

Gray Whale calves 16 to 18 feet in length are born usually in the last half of January, and are weaned 6 to 8 months later when they have grown to 25 feet.

In the Bering Sea, Gray Whales feed on several kinds of amphipods resembling sand fleas. When traveling along the shore, they submerge for 8 to 10 minutes at a time. The spout rises vertically to 10 or 11 feet.

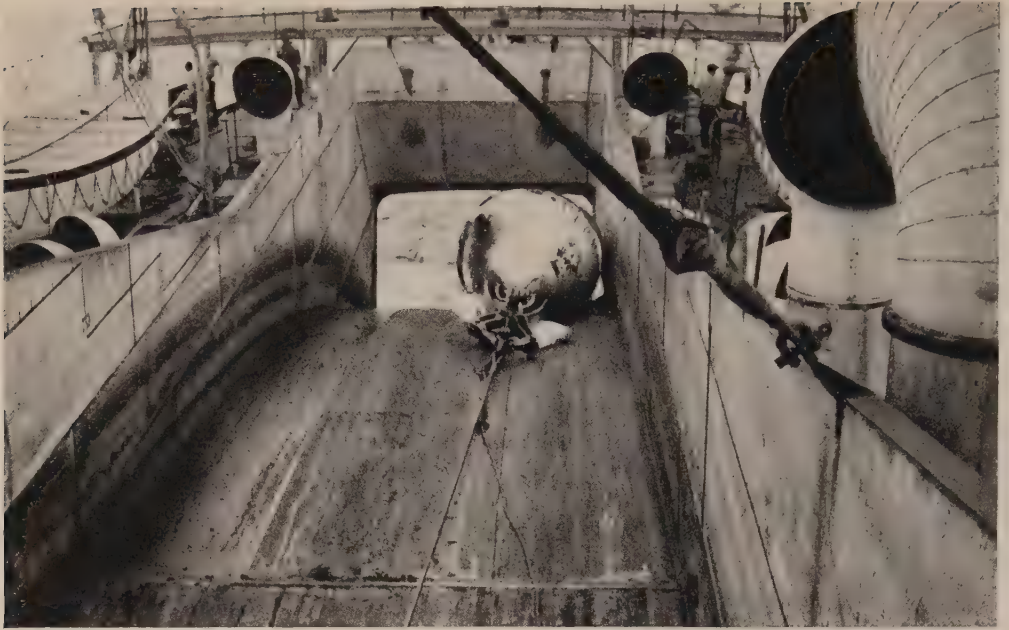
Bowhead Whale

(*Balaena mysticetus*)

Bowhead Whales formerly ranged from Spitsbergen westward to eastern Siberia, approaching the pack ice around the North Pole in summer, and moving southward again in the fall (Plate VIII). Today the few remaining Bowheads appear in Bering Strait in June and proceed eastward to the mouth of the Mackenzie River, and Baillie and Banks Islands.

From September to November, depending on ice conditions, they pass Point Barrow, Alaska, and spend the winter months in drifting field ice about the Aleutians and the Kurile Islands north of Japan.

Bowheads were hunted almost to extinction in the North Atlantic between 1612 and 1887, but meanwhile a new fishery was opened up in Bering Sea and the neighboring Arctic regions in 1848. Notwithstanding many setbacks, including the burning of whaling vessels in Bering Sea during the Civil War by the Confederate privateer *Shenandoah*, and the destruction by pack ice of the entire Arctic fleet in 1871 and 1877, whaling was continued on a rapidly diminishing scale in these waters for many years thereafter.



Photograph by Lieut. Q. R. Walsh, U. S. Coast Guard

HAULING A WHALE ABOARD SHIP WOULD HAVE ASTONISHED OLD-TIMERS

A Humpback is being pulled directly out of the ocean up the slipway at the stern of the factory ship *Ulysses*. Then it will be cut up and processed into oil and other by-products. A two-ton steel claw clamps on to the whale's tail, making it possible to haul carcasses on board the ship with a steam winch. Prior to its use, in bad weather or when the ship was rolling, whalers were sometimes drowned when they attempted to loop wire cables around the tail flukes.



© Morris D. Miller

WHALES, LIKE SHIPS, GET BARNACLES ON THEIR BOTTOMS!

This close-up shows parasites an inch or more in diameter on a Humpback Whale. They attach themselves "just for the ride," and pick up tiny organisms for food as the whale swims along. Barnacles are colored delicate shades of pink, blue, and lavender. Whales sometimes come into shallow water in an apparent effort to rub them off. The pointer indicates one of the "lice" or parasitic copepods which infest whales. They are reddish, spiderlike creatures as large as a thumbnail.

In 1897 the prices quoted at San Francisco, California, were \$4 a pound for whalebone and 30 cents a gallon for whale oil. The average yield of a Bowhead was from 1,500 to 1,700 pounds of whalebone and from 70 to 90 barrels of oil, worth in all about \$8,000.

This smooth-throated whale measures from 50 to 65 feet in length. Adults are velvety black, except for the small ash-colored area at the tip of the lower jaws, the cream-colored chin and throat, and, occasionally, white or piebald underparts. Immature individuals are bluish black and the calves are bluish gray.

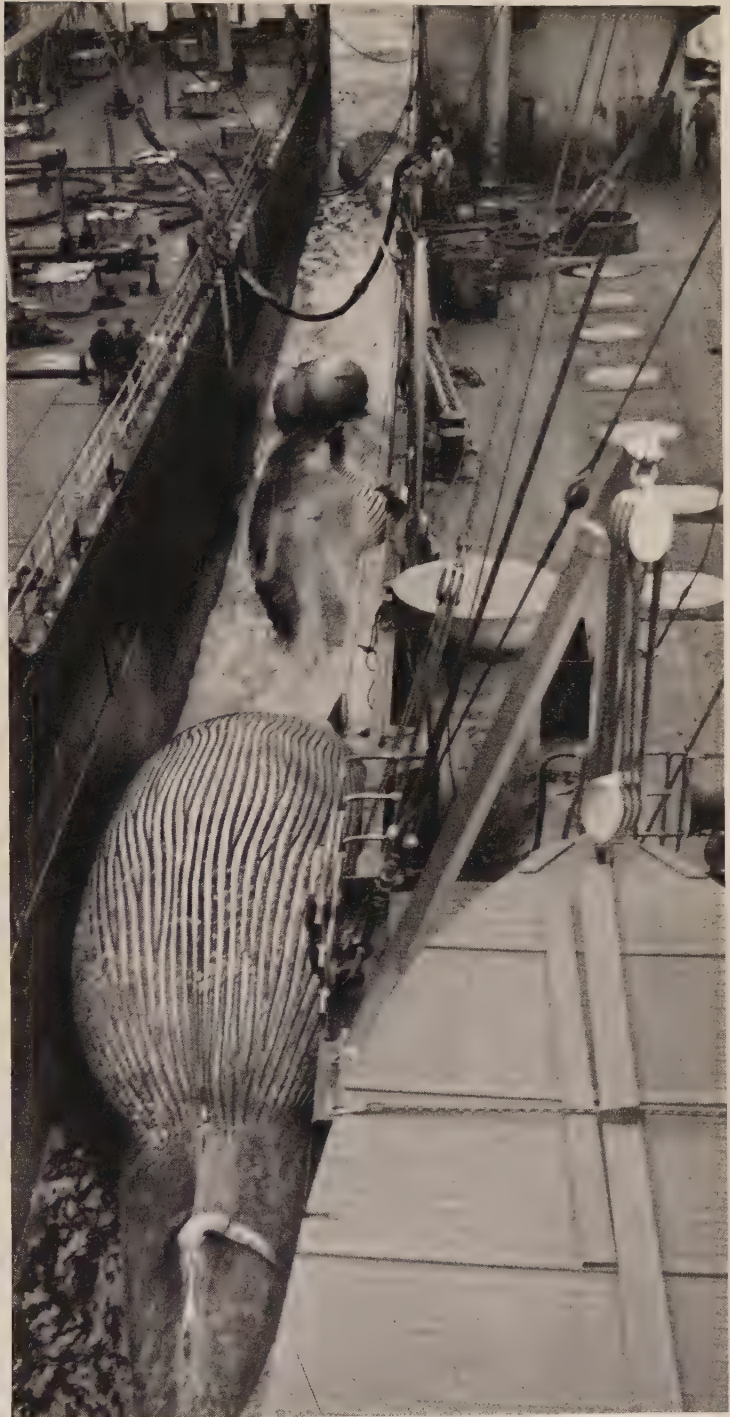
The gigantic mouth is provided on each side with a row of about 360 long, narrow, closely spaced blades of whalebone, attached at one end to the gum of the upper jaw. The blades near the middle of each row are the longest, sometimes nearly 12 feet, but decrease gradually toward each end of the row down to a few inches.

The newborn calf is rarely longer than 14 or 15 feet, and is nursed for about a year.

Bottlenose Whale (*Hyperoodon* *ampullatus*)

During the summer, Bottlenose Whales frequent the northern seas from Novaya Zemlya and Spitsbergen to the east and west coasts of Greenland, and in winter they sometimes go as far south as the Mediterranean Sea (Plate IX).

It is generally conceded that the harpooners and crews who pursue Bottlenose Whales in small boats are en-



Photograph by R. P. Randall

WHALES SERVE AS FENDERS BETWEEN TWO SHIPS

The American floating factory *Ulysses* (right) discharges whale oil through a hose (top of picture) to the tanker *California* in Antarctic waters 1,800 miles south-southeast of the Cape of Good Hope, for shipment to the United States. Floating upside down between the vessels, the carcasses show the bottom grooves of Finbacks and Blue Whales.



Photograph by Paul Pryor

ONLY THREE YEARS OLD, BUT 74 FEET "TALL"

The jaws of the skeleton of this young Blue Whale seem almost large enough to swallow the whole group of school children who are examining it. The huge shoulder blade, just behind the head, is three feet across. The Blue Whale is the largest mammal that ever lived on land or sea. This skeleton is mounted in the United States National Museum, Washington, D. C.

gaged in the most hazardous occupation of all whalemens. Because of the suddenness and unbelievable speed of the dive of one of these whales when harpooned, an accidentally entangled line may result in the capsizing of the boat or in the drowning of any seaman who is caught by a loop in the line and carried downward in the icy water.

The fore part of the head of the male Bottlenose rises abruptly from the short rostrum, or beak. A tolerably deep $\wedge$ -shaped groove is present on the throat. Old males have a single tooth, usually more or less worn, at the extremity of each lower jaw, while some young males have two teeth, barely visible.

Full-grown and aged males attain at least 30 feet. The color changes with age. Calves are black or grayish black with a leaden-gray tinge. As the animals approach maturity, yellowish-white or whitish spots appear on their flanks and underparts.

The confluence of these spots in aged females usually produces a marbled effect and sometimes an almost uniform yellowish-white coloration, or occasionally a white band around the neck. Old males are readily recognized by an

irregular whitish patch on the forehead and a white dorsal fin. Very old and large males may become almost yellowish white.

It is believed that Bottlenose Whales must dive to great depths to find squids, their principal food. Occasionally they capture herring and other fish, and at times they rummage around on the bottom taking whatever happens to be available.

Usually these whales remain submerged only 10 to 20 minutes, but harpooned animals have been known to stay under water from one to two hours. When they come to the surface after a prolonged dive, the forcibly discharged breath can be heard in still or foggy weather a mile away.

Another species (*H. planifrons*), believed to be closely related to the North Atlantic Bottlenose, frequents the Antarctic waters chilled by pack ice and at times wanders northward along the south and west coasts of Australia.

True's Beaked Whale

(*Mesoplodon mirus*)

One or more kinds of Beaked Whales belonging to the genus *Mesoplodon* inhabit the oceans

of both hemispheres, but little is known of them (Plate X). They apparently spend their lives far from shores frequented by man. These whales feed principally on squids, other cuttlefish, and occasionally fish.

Beaked Whales of this genus seldom exceed 20 feet. All have two anteriorly converging grooves that form a $\wedge$ on the throat, not more than one visible tooth in each lower jaw, and a dorsal fin placed considerably behind the middle of the animal's length. Ten kinds of Beaked Whales have been recognized.

One of the rarer species is True's Beaked Whale. It is seldom more than 17 feet long, and there is a single tooth at the very tip of each lower jaw, a character this species shares with the New Zealand Beaked Whale (*M. hectori*) and Longman's Beaked Whale (*M. pacificus*). The body is usually slaty black above and lighter beneath.

Close of kin to True's Beaked Whale are four rare types: Baird's (*Berardius bairdii*); Sowerby's (*Mesoplodon bidens*); Gervais' (*Mesoplodon europaeus*); and Blainville's (*Mesoplodon densirostris*).

Cuvier's Beaked Whale

(*Ziphius cavirostris*)

Few whales are such wanderers as the Goose-beaked, or Cuvier's Beaked Whale, as it is more often called, and yet it rarely has been seen alive by naturalists (Plate X). It has been recorded on both sides of the Atlantic Ocean, off Sweden and Rhode Island, south in the Mediterranean Sea, and off South Africa and Argentina. In the Pacific Ocean it ranges from the Commander Islands and Alaska south to New Zealand and Tasmania, and also on the coast of India.

Goose-beaked Whales attain a length of at least 28 feet. Males have a single tooth at the end of each lower jaw, which projects an inch or more beyond the gum. The thickset body has a strongly marked medial keel extending from dorsal fin to tail; the caudal flukes are not separated by a distinct notch.

The color pattern of this whale is especially variable. An 18-foot male from Ireland and a 19-foot female from New Zealand had the head, the neck, and the back in front of the dorsal fin colored a creamy white, the remainder of the body being black. Other females were purplish black above, spotted or brown on the sides, and white below.

At the mating season the males apparently not only fight among themselves but attack the females and half-grown young. Cuvier's Beaked Whale depends to a considerable extent on cuttlefish for food. Schools of 30 to 40 travel in rather close formation, swimming and diving more or less in unison. After remaining at or near the surface for about 10 minutes spouting, the school dives as if by command

and remains below searching for food for intervals up to half an hour or more.

Rough-toothed Dolphin

(*Steno rostratus*)

Few naturalists ever have had the opportunity of examining the Rough-toothed Dolphin in the flesh, and information is based largely on skeletons (Plate XI). It is found in the Mediterranean and Caribbean Seas and the Gulf of Mexico, and it ranges in the Atlantic Ocean from the North Sea to South Africa.

In the Pacific Ocean this whale has been recorded from places as far apart as Japan, Hawaii, and New Zealand. It has been identified also at Java in the Indian Ocean, the Nicobar Islands in the Bay of Bengal, and in the Red Sea.

The Rough-toothed Dolphin is readily recognized by its slender beak, which is compressed from side to side and not flattened above. The beak is not distinctly marked off by a cross groove from the receding forehead. Unlike other dolphins, the crowns of the 20 to 27 teeth on each side in each jaw are not smooth, but are roughened by fine vertical wrinkles. So far as known, this dolphin never exceeds seven or eight feet in length.

Pygmy Sperm Whale

(*Kogia breviceps*)

Strange in structure, with its habits practically unknown, the Pygmy Sperm Whale seemingly shuns the usual haunts of the larger whales (Plate XI). No naturalist has yet observed one at sea. They range as far south as Tasmania, Peru, and South Africa, and north to Japan, Baja California, and in the Atlantic to Nova Scotia and the Netherlands.

This diminutive relative of the huge Sperm Whale (Plate I) grows to a length of only 9 to 13 feet. The Pygmy is black above and light gray or grayish white beneath. It has a bluntly pointed snout, which projects beyond the lower jaw, a spermaceti organ, and a small, narrow, pinkish mouth. There are 14 or 15 slender, curved, and acutely pointed teeth in each lower jaw.

Like their larger relatives, Pygmy Sperm Whales live considerably on cuttlefish.

Blackfish, or Pilot Whale

(*Globicephala ventricosa*)

Blackfish migrate about in large schools from southern Greenland, the Faeroe Islands, and the coast of Norway to the Cape of Good Hope and the Kerguelen Islands, and in the Pacific Ocean from Japan south to New Zealand and Tasmania and east to Peru (Plate XII). Schools appear at irregular intervals along the Atlantic coast of the United States.

Among fisherfolk this animal is generally called "Blackfish" because of its black color.



Photograph by Captain C. T. Pedersen

BLUBBER FORMERLY WAS "PEELED" FROM A WHALE

Carcasses were cut up alongside the ship before the advent of the floating factory. As one might peel an apple, the blubber is being taken off in one continuous strip called the "blanket piece," which is hoisted aboard. The carcass rolls over and over as the blubber is "unwound." The men on the cutting stage at the left are using long-handled sharp-edged spades to loosen the blubber and cut the strip to the right width.

A longitudinal stripe, which expands into a heart-shaped figure on the throat, is usually present, however, on the under surface. The name "Pilot Whale" alludes to its queer habit of following the "leader," usually the largest male in the school. When one grounds in shallow water, the others follow, even though it means death for most of them. At such

times the breathing of Blackfish is said to make a bellowing noise, and this seems to be the basis for the name "Caa'ing," or Calling Whale.

In the Faeroe Islands, lookouts on hills above the bays employ smoke signals to notify the village that Blackfish have been sighted. Rushing to their boats, the villagers endeavor to drive the school into shallow water.

Keeping the boats in a line, the pursuers fire guns, beat on pans, throw rocks, and shout to frighten the school shoreward. When the Blackfish run aground, men armed with lances and knives jump into the water and cut their throats. The expected average yield from each Blackfish is about 40 gallons of blubber oil and two to two-and-a-half gallons of head and jaw oil.

Blackfish have an almost globular head, remarkably swollen in front above the very short beak, and very long but narrow flippers. Adults vary from 14 to 28 feet in length.

Many hundreds of males, females, and young are sometimes seen in a school, though the schools that come into inshore waters are generally much smaller. They travel at a fairly rapid pace, the individuals in each row rising and diving side by side, with the spouts rising perhaps five feet. Blackfish feed chiefly on squids, but eat many

kinds of fish. Calves measure at birth from five to six feet in length and are suckled for several months.

Killer Whale

(*Grampus orca*)

Killer Whales are found in all oceans and seas, tropical and polar alike, from Novaya

Zemlya, Baffin Bay, and Bering Strait to beyond the Antarctic Circle in the Southern Hemisphere (Plate XIII).

The most striking and unforgettable feature of the Killer when swimming at the surface is its erect black dorsal fin, rising like a pole every time the back comes up. The flippers and caudal flukes of young and old males are exceptionally large. Males grow to a length of 30 feet, but most females do not exceed half that size.

Killer Whales may be recognized by the bluntly rounded snout, which merges imperceptibly with the forehead, the white patch just behind and above the eye, and the striking contrast of the jet-black color of the head and back with the snowy-white underparts. They have 10 to 14 large conical teeth on each side in each of the powerful jaws which interlock when the mouth is closed.

Endowed with powerfully built bodies and ravenous appetites, Killer Whales hunt in packs of 3 to 40 individuals and habitually prey on other warm-blooded marine animals, including their own kind. The members of these schools often travel at a rapid rate in close formation, side by side, rising and diving at the same time, or cruise along at a uniform pace with their dorsal fins and part of their backs exposed.

The Killer Whale has a mouth and throat large enough to swallow seals and porpoises entire. Narwhals, White Whales, and hair seals will leave open water and frantically rush toward the beach or narrow leads in the ice on the approach of a pack of Killers. Gray Whales either become paralyzed with fright



Photograph by B. Anthony Stewart

LIKE A DOG TAUGHT TO STAND UP AND BEG, A DOLPHIN
RISES FOR FISH

With its tail lashing beneath the surface, this tame Bottlenose Dolphin (Plate XVII) in a large tank at Marineland, near St. Augustine, Florida, stands half out of water to take mullet from the attendant's hand. A bell is rung to call the dolphins to "meals" (page 86). The umbrellalike canvas is a sunshade for penguins that live in the pool.

and float belly up, or head toward the beach and slide into water so shallow that they roll in the wash. A pack of Killers, encircling a large whale, will harass and leap at it from all sides, biting at the fleshy lower lips, the flippers, and the sides until the animal either runs ashore, if near the coast, or, becoming exhausted, is literally torn to pieces.

Killers hunt for seals and penguins along the edge of pack ice and around large floes. At times when seals are basking or have taken refuge near the edge of thin ice, a school of Killers will suddenly come up beneath and endeavor to dislodge them by breaking the ice with their backs.

In the fall at the time fur seal pups are learning to swim, packs of Killer Whales cruise back and forth in the coastal waters of the Pribilof Islands, devouring hundreds of the babies. They swallow young walrus whole. Fish of all sizes also form part of their food.

White Whale

(*Delphinapterus leucas*)

White Whales are most numerous during the summer months in Arctic seas and adjacent waters as far south as Okhotsk Sea, Kodiak Island, St. Lawrence River, and Great Britain (Plate XIII). Shallow coastal waters and bays are their favorite haunts, but they also ascend rivers. White Whales have been seen in the Yukon River 600 miles from salt water and they travel up the St. Lawrence River as far as Quebec.

Near Greenland, fishermen have used motor-boats to surround and drive schools of White Whales into shallow water. On the Greenland coast they are caught in large-meshed nets supported by floats and laid outward from the shore. Leather shoestrings are manufactured from their hides and oil from the blubber.

Adult White Whales are readily distinguishable from all other cetaceans by being entirely white and by having the dorsal fin reduced to a mere ridge. They are generally 12 to 14 feet long. Ten teeth are typically present in each upper jaw and eight in each lower jaw.

Newborn calves are gray and subsequently assume shades of slate, brownish gray, or hair brown. Calves eight feet in length are generally mottled with chocolate brown. As the calves approach maturity, they assume a yellowish color before acquiring the adult milk-white skin.

The White Whale is a fast swimmer, attaining a speed of at least six miles an hour, and readily outdistances the Narwhal. It is usually very shy and sensitive to movements or sounds in or on the water, but is said to disregard those emanating from the land.

White Whales consume large quantities of fish, squids, and prawns. When salmon are running in Okhotsk Sea during July and August, the whales are especially abundant off the mouths of rivers.

Dall's Porpoise

(*Phocoenoides dalli*)

One of the creatures most frequently noticed by passengers on steamships following the In-

side Passage from Seattle, Washington, to Juneau, Alaska, is this black and white porpoise (Plate XIV). Less frequently it is seen around Kodiak Island and among the Aleutians. During June it has been sighted as far south as the Santa Barbara Channel off southern California.

A first cousin (*P. truei*) of this species frequents the waters around northern Japan. It differs from Dall's Porpoise in having the white area on the sides extending forward beyond the flippers. Both types are restricted to the North Pacific Ocean.

When Dall's Porpoise breaks the water at the surface, the white lateral area contrasting sharply with the jet-black body and the low triangular dorsal fin serve as instant recognition marks. There is a strong dorsal longitudinal ridge in front of the tail flukes. Dall's Porpoise measures, when fully grown, as much as 6 feet 2 inches and weighs about 200 pounds. Its food consists almost entirely of squids, but occasionally small fish, such as the saddled blenny, are eaten. The presence of this fish in the stomach contents suggests that this porpoise, when feeding, may nose around submerged rocks along the shore.

Right Whale Dolphin

(*Lissodelphis borealis*)

Small schools of these dolphins wander about in the vast depths of the North Pacific Ocean, generally far offshore, from the latitude of San Diego, California, to Bering Sea (Plate XIV). On the other side of the Pacific they are found off the coasts of Japan. Right Whale Dolphins are so called because of the absence of a dorsal fin, a character they share with the larger Right Whale (Plate III).

Rather slender in proportion to its length and having a short but distinct beak, this dolphin attains a length of at least eight feet. It is perhaps the sleekest and handsomest of all the dolphins, the velvet-black color of the upper parts, the flippers, and the tail flukes contrasting with the white areas on the underparts.

Our knowledge of this dolphin's actions when swimming rests solely on the observations of Titian R. Peale, who accompanied the United States Exploring Expedition of 1838-42 commanded by Charles Wilkes, U. S. N. He reported them to be remarkably quick and active and said they frequently leap out of water. They feed largely on cuttlefish and fish.

Péron's Dolphin (*L. peronii*), a related species, inhabits the southern seas from the longitude of Chile to New Zealand and Tasmania. Its beak, as far as the eye, is silky white, and so are the sides, the flippers, the tail flukes, and the entire underparts; the top of the head and the back are black or bluish black. It is somewhat smaller than its northern relative, measuring about six feet in length.

WHALES, PORPOISES, AND DOLPHINS



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Painting by Else Bostelmann

BOTTLENOSE DOLPHINS ARE CAUGHT IN NETS ON HATTERAS ISLAND, NORTH CAROLINA

The school first was encircled by the "out net," shown in the distance, which may be half a mile long, and then pulled ashore in the "sweep net." A school was last taken there in 1929. Oil from sacs in the forehead and behind the lower jaw is used in chronometers. The beak of the **Bottlenose Dolphin** is supposed to resemble the top of an old-fashioned gin bottle.



ALMOST BLIND, THE GANGES DOLPHIN PROBES FOR FOOD WITH ITS SNOOT
Sharp teeth line the beak, used to dig out fish in the bottom mud. The **Ganges River Dolphin** never goes to sea, but stays the year round in the rivers of northern India.



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Paintings by Else Bostelmann

THE IRRAWADDY PORPOISE TRAVELS 900 MILES UP ITS NAMESAKE STREAM

It is native to the southern Asiatic coast. The **Irrawaddy River Porpoise** has the strange habit of squirting water from its mouth, and likes to roll over and over on sand bars in shallow water.

WHALES, PORPOISES, AND DOLPHINS



Painting by Else Bostelmann

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SWIMMING AHEAD OF SHIPS IS SPORT FOR THE LONG-SNOUDED DOLPHIN

Stationing themselves just in front of a vessel, **Long-snouted Dolphins** seem to ride the bow wave as if they were guiding the ship on its course. The calf, a uniform gray color, swims close to its white-spotted mother. These dolphins can swim at a speed of 12 to 15 knots. They play about ships for long periods, easily keeping up with them on the surface, rolling and jumping out of water. In the distance **Bottlenose Dolphins** are leaping (Plate XVII).



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GRACEFUL COMMON DOLPHINS, OMENS OF GOOD LUCK TO SAILORS, SHARE A SEAFOOD MEAL WITH A HARBOR PORPOISE

Painting by Else Bostelmann

Passengers on ocean liners often see schools of the **Common Dolphin** sporting in the sea. This animal is so fast that it can capture flying fish. The **Harbor Porpoise**, however, sticks to the shore.



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A GIANT SQUID FIGHTS A BATTLE-SCARRED RISSEO'S DOLPHIN, WHILE A SCHOOL OF FALSE KILLER WHALES SWIMS PAST
Painting by Elise Bostelmann



ASIATIC COASTAL WATERS ARE THE HAUNTS OF A FINLESS PORPOISE
A low ridge replaces the dorsal fin. Some Asiatic religious sects, forbidden to eat meat, class the **Black Finless Porpoise** as a "fish" and thus get a change of diet.



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Paintings by Else Bostelmann

COMMERSON'S DOLPHINS FROLIC IN THE STORMY STRAIT OF MAGELLAN

Hundreds of the animals often play about ships passing through these waters, the white areas of their bodies flashing like mirrors in the sun. The coloring of **Commerson's Dolphins** probably helps them escape killer whales prowling among ice floes (Plate XIII).

WHALES, PORPOISES, AND DOLPHINS



WHITE FLAG DOLPHINS ARE FOUND ONLY IN TUNG TING LAKE, CHINA

This body of water, about 600 miles up the Yangtze River, is their sole habitat. The dorsal fin of the **White Flag Dolphin** is supposed to resemble a flag when seen above the water.



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Paintings by Else Bostelmann

EQUALLY AT HOME IN SALT OR FRESH WATER IS THE GUIANA RIVER DOLPHIN

It lives off the coasts of Surinam, British and French Guiana, and travels up the streams of these three colonies. Relatives of the **Guiana River Dolphin** have been seen swimming in flooded forests more than 1,000 river miles from the sea. Crocodiles submerge when they appear.



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Painting by Else Bostelmann

NARWHAL TUSKS ONCE WERE TRADED AS HORNS OF THE MYTHICAL UNICORN

As such, they were highly prized in medieval times for supposed medicinal qualities. The tusk of the **Narwhal**, which may reach a length of nine feet, is hollow and too brittle to use as a weapon. It grows only on males, and is spiraled clockwise. This school, accompanied by a grayish calf, is being hunted by Eskimos in kayaks among Arctic icebergs.

La Plata Dolphin

(*Stenodelphis blainvillii*)

Among the lesser-known kinds of dolphins that are found solely in the Southern Hemisphere, the La Plata Dolphin is recognized as being the most specialized, not only in its skeletal construction but in its outward form (Plate XV). It seems to prefer the estuaries of fresh-water rivers, but appears occasionally in coastal waters on the Atlantic side of South America.

The record length and weight for a female are respectively 68 inches and 88 pounds; full-grown males are at least 6 inches shorter and weigh approximately 70 pounds. Their dull coloration, small size, and unobtrusive habits tend to render them quite inconspicuous and protect them from the attacks of some of their more cannibalistic relatives. They travel, feed, and breed in small schools. The newborn young are surprisingly small, measuring about 18 inches in length and weighing 15 pounds.

La Plata Dolphins delight in coming alongside fishing boats and thus are readily captured by fishermen. They rarely are seen in the Plata estuary during the winter. Perhaps at this season most of the schools migrate northward along the Brazilian coast or frequent the high seas in approximately the same latitude.

Their teeth, quite long, slender as toothpicks, and sharply pointed, are marvelously adapted for catching and holding soft-bodied prey. The food of this dolphin consists chiefly of the silvery mullet which swim in shoals and certain croakerlike fish which are noted for their ability to make a drumming noise.

Amazon River Dolphin, or Boto

(*Inia geoffrensis*)

Geological ages ago, as shown by fossils, the family Iniidae, to which this river-dwelling dolphin belongs, was widely distributed in the waters of the world, but today there are only two survivors, the White Flag Dolphin in Tung Ting Lake, China (Plate XXIII), and the Boto in South America (Plate XV).

All reports indicate that these dolphins are numerous in the Amazon River, from the long reach where the Tocantins empties into it, to and including most of its principal tributaries. The Botos travel upstream at least to Nauta, Peru, on the Marañón, and follow some of the latter's smaller tributaries to lakes at the foot of the Cordilleras.

In Bolivia they inhabit the rivers that drain the immense Plains of Mojos and empty into the Guaporé and Mamoré Rivers, several hundred miles upstream from the falls on the Madeira. They ascend the Purús at least as far as Hyutanahan, penetrate far upstream in the Negro and the Branco, and enter some of the smaller tributaries of these rivers.

They have been seen in the Tacutú River,

which forms part of the boundary between British Guiana and Brazil. On the Venezuela border, the Casiquiare River connects the Negro with the Orinoco, and through this channel the Boto makes its way from the Amazon to the Orinoco.

The Botos in the large rivers generally have pale-bluish, bluish-gray, or even flesh-colored upper parts, but those that wander into the larger lakes during the season of heavy rains are often blackish. The underparts are paler, usually whitish but sometimes pinkish.

Full-grown males attain a length in excess of nine feet. The slender and almost cylindrical beak is curved slightly downward. The Boto comes to the surface to breathe more frequently than the oceanic dolphins. It feeds on fresh-water fish, including those that are habitually found on river bottoms.

White-beaked Dolphin

(*Lagenorhynchus albirostris*)

One of the most abundant of all the North Atlantic toothed whales is the White-beaked Dolphin, which seems to prefer the colder northern waters from southern Greenland as far north as Sukkertoppen, on Davis Strait, and the Tromsø coast of Norway (Plate XVI). Schools are present in the North Sea throughout the year. On the American side of the Atlantic they are rarely seen south of Labrador.

The White-beaked Dolphin may be recognized at once by its white beak, about two inches long, separated from the sloping forehead by the usual cross groove. The dark color of the upper parts usually extends downward to the base of the blackish upper surface of the rather broad flippers. Old adults rarely exceed 10 feet in length.

This dolphin is protected from the cold of the northern waters by a thick coating of blubber. Vast schools of as many as 1,500 or more are often seen. Stomachs of these animals have been found packed with the undigested bones of whiting, claws of hermit crabs, and horny parts of the common whelk, a mollusk used in dyeing purple. They also feed on capelin, cod, squids, and crustaceans.

White-sided Dolphin

(*Lagenorhynchus acutus*)

Both summer and winter, schools of White-sided Dolphins roam about in the North Atlantic Ocean, from southern Greenland and the North Sea as far north as the Arctic Circle on the coast of Norway, and south to the British Isles, the Netherlands, and Cape Cod, Massachusetts (Plate XVI).

This dolphin is readily recognized by the lighter area on each side of the body below the dorsal fin, and by the conspicuous elongated yellowish-brown and grayish lateral streaks above the white underparts. Its beak is about



Photograph by B. Anthony Stewart

HIS SLOGAN—"A DEAD WHALE OR A STOVE BOAT"

Portraying the spirit of the whalers of a century ago, this monument at New Bedford, Massachusetts, shows the harpooner about to plunge his iron into a whale. The line is passed through a slot in the bow, ready to pay out when the quarry dives after being struck. A stove boat was a not-infrequent occurrence, for the small craft sometimes was crushed in the jaws of a maddened Sperm or smashed by its lashing flukes (page 64, and Plate I).

two inches long, always black, and separated from the sloping forehead by a cross groove. This dolphin grows to nine feet, the males being slightly larger than the females. Schools numbering more than a thousand have been observed in the North Sea.

Close of kin to these North Atlantic types are half a dozen or so kinds of short-beaked dolphins that frequent the southern and circumpolar seas. The North Pacific striped dolphin (*L. obliquidens*) has been known to visit Monterey Bay and Puget Sound, but seems to be most numerous along the coasts of Japan.

Bottlenose Dolphin

(*Tursiops truncatus*)

Despite the similarity in names, the Bottlenose Dolphin is unlike the Bottlenose Beaked Whale either in general appearance or in size (Plate XVII). These dolphins are common in the North Atlantic and are found in the North and Baltic Seas, the Bay of Biscay, the Mediterranean and Black Seas.

They are the most numerous of all dolphins along the Atlantic coast of the United States, ranging according to season from Maine to Florida and Barbados, and along the Gulf coast.

Other species closely allied to this dolphin live in the North Pacific Ocean, the Australian seas, where they are known as "Cowfish," the Indian Ocean, the Red Sea, the coastal waters of South Africa, and along the coasts of Argentina and Brazil.

Stranded Bottlenose Dolphins may

be recognized by the purplish lead-gray upper parts, the short beak, seldom more than three inches long, the lower jaw slightly longer than the upper, and 20 to 26 teeth on each side in each jaw. Adults attain a length of 11 or 12 feet.

Large schools numbering several hundreds, scattered over the ocean for half a mile or so, have been seen near the Galápagos Islands. Spectacular leaps are often made by members of a school as it passes near a ship. On coming to the surface, the dolphin cuts the water cleanly and may rise twice its own length above the surface before plunging nose first or falling on its back or side.

Fishermen say that the very young calf swims a little ahead of its mother and that it is pushed to the surface each time she rises to breathe. Along the Hatteras coast, Bottlenose Dolphins feed on squeteague, or weakfish, and elsewhere on various shoal fish.

Ganges River Dolphin, or Susu

(*Platanista gangetica*)

The distinguishing features of this dolphin are the long, slender, compressed beak with its formidable array of teeth, wedge-shaped forehead, small, degenerate, lensless eyes, longitudinal slitlike blowhole, distinctly constricted neck, low, ridgelike dorsal fin, and broad flippers cut off squarely at their ends (Plate XVIII).

The inoffensive Susu may remain at the bottom of a river probing about in the mud for two minutes. Being almost blind, it must be guided to its food by the sense of touch in its long snout.

Irrawaddy River Porpoise

(*Orcella brevirostris*)

This beakless porpoise is an inhabitant of the warmer Asiatic coastal waters (Plate XVIII). Its geographic range extends from the mouths of the Ganges through the Strait of Malacca to Borneo on the China Sea and northward into the Gulf of Siam. Schools travel up the Irrawaddy River more than 900 miles from salt water.

In India the oil from the blubber is rubbed on externally as a remedy for rheumatism. Burmese fishermen along the Irrawaddy River believe that this porpoise purposely leads fish into their nets.

The Irrawaddy Porpoise is slate blue above and lighter below. Males reach a length of at least 7½ feet. There is a rounded forehead that curves regularly from the upper lip to the blowhole, moderately long and broad triangular flippers, and the dorsal fin is located behind the middle of the animal's length, with a low dorsal ridge back of it.

This porpoise rises to breathe at intervals varying from 70 to 150 seconds, emitting each time a short blowing noise. It has a habit of squirting water from its mouth, generally straight ahead, but sometimes upward.

Long-snouted Dolphin

(*Stenella plagiodon*)

Schools of Long-snouted Dolphins are often seen by passengers on the coastwise steamships that pass within sight of the Diamond Shoal Lightship near Hatteras, North Carolina (Plate XIX). From a distance these dolphins appear very dark, almost black, above and paler beneath. At closer range the white spots on the purplish-gray upper parts are conspicuous, and as the dolphin rolls at the surface the



Photograph by Maynard Owen Williams

HORN OF THE "SEA UNICORN"

This tusk is about eight feet long and was taken from a Narwhal killed by Eskimos in a fjord near Godthaab, Greenland (Plate XXIV).



© Leon Daniel from Pix

TRAPPED BY FALLING TIDE, A HERD OF WHALES MEETS DEATH ASHORE

Part of a school of more than 200, these False Killer Whales (Plate XXI) were cut off from the sea by sandy shoals when the tide went out near Mamre, South Africa, on November 19, 1935. Stranded on their backs in rocky crevices, they could not breathe through their blowholes, and died of suffocation and exhaustion from their struggles. They are smaller relatives of the true Killer Whale (Plate XIII). Sharp teeth line both upper and lower jaws.

lighter flanks speckled with white or gray spots may be clearly seen. This dolphin and all of its close kin have a relatively long beak.

Long-snouted Dolphins do not grow much longer than 7 feet and weigh around 280 pounds. The small gray calf swims alongside its mother invariably between the fore flipper and the caudal flukes, both rising and sinking in unison. A sucking fish, the remora, adhering to the fore flipper or to the side of the tail of one of the dolphins, at times has been mistaken for the calf. This has given rise to the erroneous belief that the calf grasps the fore flipper or the caudal flukes of the mother and thus is towed along.

Like most of its relatives, this dolphin feeds on fish. It swims with so little apparent effort and at such speed that the human eye can barely follow the animal's beak as it snaps up its prey. Great schools of another related spotted dolphin (*Stenella graffmani*) are frequently seen in the Pacific Ocean in coastal waters northward at least to Acapulco, Guerrero, Mexico, and southward to Gorgona Island, off Colombia.

Common Dolphin

(*Delphinus delphis*)

This handsome ring-eyed dolphin frequents the high seas, but is found in much larger numbers in warm or temperate than in colder waters (Plate XX). Nevertheless, it follows the Gulf Stream as far north as the bleak coasts of Finnmark, Norway. Common Dolphins are especially abundant in the waters about Gibraltar, the Mediterranean, and Black Sea. A similar type is found in the Pacific and Indian Oceans.

Since the days of the Phoenician mariners, the appearance of dolphins alongside a ship has been regarded by sailors as an omen of good fortune, fair weather, and steady winds.

The Common Dolphin grows to a length of 8 feet 6 inches, and has a tapering beak about 6 inches long which is sharply marked off by a deep V-shaped groove from the low sloping forehead. It may be recognized by the saddlelike expansion of the dark upper parts about midway to the flukes. After the dolphins have overtaken a ship and are racing alongside toward the bows, the distinctive arrangement of the colored stripes on the flanks can be seen at the time they make curving leaps clear of the surface and enter the water head-first with hardly a splash.

The Common Dolphin usually travels in schools and is in the habit of accompanying ships for considerable distances, hovering alongside and executing intricate maneuvers. It can pass ships traveling at 15 or 18 knots (pages 39 and 87).

The teeth of both jaws interlock perfectly, and, being sharply pointed and curved backward, are very effective for catching and hold-

ing slippery fish. These dolphins take their food whole and swallow it head first.

Harbor Porpoise

(*Phocaena phocaena*)

Harbor, or Common Porpoises, as they are often called, are found in the North Atlantic Ocean as far north as Iceland and Davis Strait and in the White Sea (Plate XX). They are abundant in the Baltic Sea, around the British Isles, and range south to the Strait of Gibraltar and Cape May, New Jersey.

Similarly, a related porpoise (*P. vomerina*) ranges along the Pacific coast of North America from the Pribilof Islands in Bering Sea southward to Banderas Bay, Mexico. Several kinds of porpoises, probably not all distinct, have been described from the coastal waters of Argentina, Chile, and South Africa.

Four to six feet is the usual length of the Harbor Porpoise. It has a blunt, rounded snout, but no distinct beak, and is readily distinguished from all other small cetaceans by having teeth with peculiar spadelike crowns.

Harbor Porpoises usually travel along the coasts in schools numbering from a few to 50 or even 100, and rarely are seen very far offshore. This porpoise usually swims just below the surface and rises to breathe about four times a minute. The breath is expelled from the lungs with a low puffing or hissing noise as the snout and top of the head break the surface.

The calf at birth measures from 30 to 34 inches, and is suckled by the mother while she floats or swims slowly partly on her side. The Harbor Porpoise feeds according to season on herring, pilchard, mackerel, whiting, rock cod, small salmon, and eels, as well as on squids and occasionally crustaceans.

Risso's Dolphin

(*Gramphidelphis griseus*)

Risso's Dolphin is widely distributed (Plate XXI). It has been seen near the Cape of Good Hope, New Zealand, South Australia, the Netherlands Indies, in the China Sea, along the coast of Japan, and at Monterey, California. It is numerous in the Mediterranean as far east as the Adriatic, and ranges from the Azores northward along the coasts of Europe to the Shetland Islands in the North Sea and the Swedish coast in the Baltic Sea. A few have been taken at Cape Cod, Massachusetts, and on the coast of New Jersey.

One of these dolphins, "Pelorus Jack," became so well known from its habit of playing about the bows of passing vessels at the entrance to Pelorus Sound in New Zealand that it was given protection for its natural life by an Order-in-Council. This dolphin accompanied vessels for about 32 years and was last seen in 1912. Risso's Dolphin is frequently called "grampus," owing to a confusion of



Photograph by B. Anthony Stewart

FRIENDLY BOTTLENOSE DOLPHINS "EAT OUT OF THE HAND" OF A DIVER IN THE TANK AT MARINELAND, FLORIDA

The animals snap up and swallow mullet which are given to them from the basket (Plate XVII and pages 71 and 90). The diver keeps one eye on the dangerous sting ray just visible in the foreground. The big jewfish on the bottom at right is blind and must be fed by hand.



LEAPING IN UNISON LIKE WELL-DRILLED TROOPS, COMMON DOLPHINS FROLIC BEFORE A LINER IN THE INDIAN OCEAN

Photograph by Acme



© C. Anders & Co.

DIVING AND LEAPING TOGETHER, A DOLPHIN "FAMILY" PLAYS ABOUT A SHIP

Their sleek bodies strongly arched, the quartet begins a shallow dive with tails lifted and heads almost entirely submerged. The dolphin on the left is half grown, and the second one is a calf still young enough to nurse, yet able to keep up with the adults. There was an old belief that the souls of dead sailors entered dolphins, and that the bodies of drowned men were carried ashore on their backs.

names in the early part of the past century.

It differs from all other dolphins in that the few teeth it possesses are, as a rule, restricted to the front end of the lower jaws. Two to seven pairs of teeth, often worn down to the gums, may be present. It has a bluntly rounded head, and moderately long and narrow flippers. The maximum length of adults is 12 or 13 feet.

When this dolphin is breathing at the surface, the slender recurved dorsal fin at once betrays its identity. Males are mainly bluish white with dark-brown patches and females a uniform brown.

The whitish streaks and blotches often seen on the bodies of these dolphins probably are scars made by the circular suckers, armed with claws, on the arms of the giant squid.

False Killer Whale

(*Pseudorca crassidens*)

With the possible exception of the polar seas, False Killer Whales wander in all oceans, in schools of hundreds of individuals (Plate XXI). The sporadic appearance in inshore waters during the past 30 years of large schools of False Killer Whales, a species that hitherto had been regarded as rare, is perhaps the most extraordinary happening in the entire history of cetology. It is believed that some of these invasions have coincided with the flooding shoreward of warm ocean currents, which influenced the distribution of fish and other sea life on which the whales feed. Hundreds of individuals have been stranded when schools of False Killers invaded shoal water and were trapped by the falling tide (page 84).

The False Killer may be distinguished by its flattened head, bluntly rounded snout, and absence of any vestige of a beak. It has slender, tapering flippers, 8 to 12 rather strong teeth on each side in each jaw, and a low recurved dorsal fin. Occasionally the uniform black color of the body is broken up by a number of light-colored, star-shaped scars. The largest individuals rarely exceed 18 feet in length, and weigh $1\frac{1}{2}$ tons.

Black Finless Porpoise

(*Neomeris phocaenoides*)

This porpoise is a native of Asiatic coastal waters from western India to Sarawak, Borneo, southern Japan and Korea (Chosen). It prefers warmer inshore waters but ascends freshwater rivers, and travels up the Yangtze for at least 1,000 miles to the Ichang Gorge in Hupeh Province (Plate XXII).

Full-grown males are a little over five feet long. The color of this pink-eyed porpoise in life is leaden black on the upper parts and lighter beneath. Pale-gray areas, and sometimes even purplish-red patches, are present on the throat and lips. Unlike all of its close relatives, this porpoise lacks the usual type of

dorsal fin, which is replaced on the third quarter of the body length by a fairly prominent compressed dorsal ridge. The forehead rises abruptly from the tip of the upper jaw.

When feeding in coastal waters, the Black Finless Porpoise lives chiefly on prawns, cuttlefish, and squids.

Commerson's Dolphin

(*Cephalorhynchus commersonii*)

This dolphin was discovered off the coast of Tierra del Fuego and in the Strait of Magellan, and its range extends in the South Atlantic Ocean from the latitude of Bahía Blanca, Argentina, to the boisterous seas beyond the latitude of Cape Horn (Plate XXII). There are a number of dolphins close of kin but markedly different in color pattern in the southern seas.

Aside from its distinctive color pattern, this dolphin is distinguished from its first cousins by the short beak which is not sharply marked off from the receding forehead, 29 to 30 teeth on each side in each jaw, the low rounded dorsal fin, and the more or less rounded ends of the flippers. It rarely exceeds 4 feet 6 inches in length.

The food of this dolphin consists mainly of squids supplemented by the small shrimplike crustaceans that swarm at the surface of southern oceans during the summer months.

White Flag Dolphin

(*Lipotes vexillifer*)

Although a member of the once widely distributed family that includes the Amazon River Dolphin, or Bouto (Plate XV), the Chinese White Flag Dolphin today is restricted to the fresh-water Tung Ting Lake in Hunan Province, China, some 600 miles up the Yangtze River (Plate XXIII).

Fishermen seem reluctant to capture this dolphin, chiefly because of their belief that it is a descendant of a princess who flung herself into the lake. If one of the animals is accidentally killed, however, the Chinese will utilize it. They use the blubber to treat colds and other ailments, both externally and internally.

The White Flag Dolphin grows to 7 feet 6 inches and weighs about 300 pounds. It is gray or bluish gray on the upper parts and white on the underparts. The beak is curved upward and is fully a foot in length.

The animal feeds on fish which it finds in the mud on the bottom of the lake. But for its beak, peculiarly adapted for probing about in the mud, the creature might experience some difficulty in finding food, since it is blind or nearly so.

Guiana River Dolphin

(*Sotalia guianensis*)

This dolphin inhabits the coastal waters as well as the streams of Surinam, British and



Photograph by Willard R. Culver

AN EXUBERANT DOLPHIN SEEMS TO JUMP FOR JOY

This Bottlenose is sporting near a ship off the Rhode Island shore. The animals may leap as much as twice their own length above the surface, and in captivity have been known to turn somersaults. This dolphin is one of the types frequently seen along the Atlantic coast (Plate XVII).

French Guiana (Plate XXIII). About a dozen species of *Sotalia* inhabit the tropical coastal waters or rivers of South America, Africa, India, and the lands bordering the China Sea.

Two of the three species native to the Amazon often are found in its smaller tributaries, 1,500 or more miles upstream from the sea. When the German scientist, Alexander von Humboldt, was traveling by boat along the Río Temi to Yavita on the Venezuela-Colombia frontier, his Indian boatmen usually followed open leads through the inundated forest. In the thickest part of the forest where the depth of the water was not more than half a fathom, Humboldt was astonished to see a school of these fresh-water dolphins suddenly appear around his boat.

The Guiana River Dolphin differs from others in having a slimmish body, a relatively large dorsal fin, and a peculiarly shaped slender beak. It is usually about five feet long. The dull lead-colored or brownish upper parts blend on the lower third of the sides with the pinkish or violet-gray underparts.

Narwhal

(*Monodon monoceros*)

Narwhals are inhabitants of Arctic seas and under favorable open-water conditions wander

along the Arctic coasts of the Old and New Worlds (Plate XXIV).

The male Narwhal differs from all other whales and porpoises in having the left upper jaw armed with a clockwise spirally twisted tusk, which occasionally measures more than nine feet (page 83). The Narwhal never has been known to use its tusk as a weapon. The tusks were first taken to Europe as articles of trade by Norsemen from Iceland and Greenland.

Narwhals generally migrate in large herds. In the spring when the ice is rotten and cracked, they frequent the openings, apparently to escape being attacked by Killer Whales.

The calves, which are gray, and five feet in length at birth, remain with the mother for a long time. The shrill whistle made by the Narwhal just as it bobs up out of the water may result from forcing the respiratory blast through the water. The deep roar or short low-pitched blast sometimes heard may be made by the nostrils of a mother calling to her calf.

Cuttlefish, skate, turbot, rock cod, salmon trout, sea scorpions, and shrimps have been found in Narwhal stomachs, and small halibut and flounders are among their favorite foods. Fish are crushed between the jaws and swallowed without mastication, since there are no functional teeth.

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